

Prepared By:



Municipality of Brockton Greenock Structure No. 0002

Schedule 'B' EA Project File (Version 1)

GMBP File: 212326

October 22, 2020



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SCHEDULE 'B' EA PROJECT FILE (VERSION 1)

GREENOCK STRUCTURE NO. 0002 MUNICIPALITY OF BROCKTON

OCTOBER 22, 2020

GMBP FILE: 212326

1. INTRODUCTION

GM BluePlan Engineering Limited (GMBP) was retained by the Municipality of Brockton to undertake a planning process to address the deteriorated condition of Bridge No. 0002 (Greenock) on Bridge Street in Riversdale (Lot 30, Concession 1N), just north of Highway 9, where shown on **Figure 1**. The Municipal Engineers Association (MEA), in cooperation with the Ministry of the Environment, Conservation and Parks (MECP), has developed a Municipal Class Environmental Assessment (EA) process to assist in planning projects of this nature.

The EA planning process develops a Project Statement, considers alternative solutions, and documents the public consultation process toward the selection, by Council, of a *Preferred Solution* to the Project Statement in a Project File. Since the alternative solutions consider alteration of a structure that is over 40 years old, which has been determined to have cultural heritage value and which would likely have a project cost of less than \$2.4M, a Schedule 'B' EA process is considered appropriate for this undertaking at this time.

The Project Statement is considered as follows:

'Inspection Reports for the aging Riversdale Bridge (Greenock Structure No.0002) note advanced deterioration of the superstructure and substructure to a point where the bridge is no longer able to fulfill its intended function and, therefore, consideration should be given to addressing a long-term solution.'

The Project File is considered a "living document". This initial version of the Project File is issued to present the Project Statement; identify the range of Alternative Solutions considered to address the problem or opportunity; evaluate the anticipated 'environmental' effects and proposed mitigation; and to provide a preliminary assessment and evaluation of alternative solutions and the rationale for the selection of a *Preliminary Recommended Solution*.

This initial version of the Project File is issued to the Public, Agencies, and Indigenous Communities for consultation purposes. The *Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)* was first advertised on October 22, 2020. The Notice includes an invitation to the public, agencies and Indigenous Communities to review and provide comments on the Project File. Comments received through the consultation process will be incorporated into a subsequent revision to this Project File, including an updated Evaluation of Alternatives, ultimately with a *Recommended Preferred Solution* presented for consideration and acceptance (or otherwise) by Council.

2. MUNICIPAL CLASS ENVIRONMENTAL ASSESSMENT PLANNING PROCESS

Municipal infrastructure projects are subject to the Ontario Environmental Assessment Act (EA Act). The Class Environmental Assessment (Class EA) is an approved self-assessment process under the EA Act for a specific group or “class” of projects. Projects are considered approved subject to compliance with an approved Class EA process. The Municipal Class EA (Municipal Engineers Association October 2000, as amended in 2007, 2011 and 2015) applies to municipal infrastructure projects including roads, water and wastewater.

The Municipal Class EA outlines a comprehensive planning process (illustrated in **Figure 2**) that provides a rational approach to consider the environmental and technical advantages and disadvantages of alternatives and their trade-offs in order to determine a *Preferred Solution* to address an identified problem (or opportunity), as well as consultation with agencies, Indigenous Communities, directly affected stakeholders and the public throughout the process. The key principles of successful environmental assessment planning include:

- Consultation;
- Consideration of a reasonable range of alternatives;
- Consideration of effects on natural, social, cultural, and economic environments and technical components;
- Systematic evaluation;
- Clear documentation; and
- Traceable decision making.

The classification of projects and activities under the Municipal Class EA is as follows:

Schedule A: Includes normal or emergency operational and maintenance activities, which are limited in scale and have minimal adverse environmental effects. These undertakings are pre-approved and the proponent can proceed without further assessment and approval.

Schedule A+: Introduced in 2007, these minor projects are pre-approved. The public is to be advised prior to the implementation of the project.

Schedule B: Includes projects which have the potential for adverse environmental effects. This includes improvements to, and minor expansions of, existing facilities. These projects are approved subject to a screening process which includes consulting with stakeholders who may be directly affected and relevant review agencies.

Schedule C: Includes the construction of new facilities and major expansions to existing facilities. These undertakings have the potential for significant environmental effects and must proceed under the planning and documentation procedures outlined in the Municipal Class EA document.

This Project File includes documentation of the Schedule ‘B’ EA process, which is in accordance with the requirements of the Municipal Class EA process and includes Phases 1 and 2, depicted on **Figure 2**:

- Phase 1 consists of identifying the problem or opportunity, and optional (discretionary) public consultation if deemed suitable.
- Phase 2 involves identifying reasonable alternatives to the problem or opportunity, compiling an inventory of the natural, cultural, social, technical and economic environments, evaluating each alternative and recommending a preferred alternative that will address the problem, and provide any measures necessary to mitigate potential environmental impacts. Public, agency and indigenous community consultation is required at this stage before the *Preferred Solution* is selected to ensure all possible impacts are identified, and assessed, as part of the evaluation process.

For Schedule 'B' or 'C' projects, a *Notice of Project Initiation* is advertised and the *Preferred Solution* (and for Schedule 'C' projects, the *Preferred Design*) is developed through the process; to be confirmed by Council. The entire process is documented in a Schedule 'B' Project File, or Schedule 'C' Environmental Study Report, which is made available for public, agency and indigenous community review during a 30 calendar day period following the issuance of the *Notice of Project Completion*. Project Notices are included in **Appendix A**.

For Schedule 'B' and 'C' projects, all comments and concerns raised by the public, stakeholders and/or agencies during the review period, following advertisement of the *Notice of Completion*, are to be addressed directly to the proponent (i.e. the Municipality). However, if concerns are raised during the review period that are specific to aboriginal or treaty rights, that cannot be resolved through discussions with the Municipality, then a Part-II Order request to the Ministry of the Environment, Conservation and Parks (MECP) may be made.

Requests specific to aboriginal or treaty rights should specify what kind of order is being requested (i.e. additional conditions, higher level of study, individual EA, etc.), how an order may prevent, mitigate or remedy those potential adverse impacts on constitutionally protected Aboriginal and treaty rights, and any information in support of the statements in the request. Requests on other grounds will not be considered. This will ensure that the Ministry is able to efficiently begin reviewing the request. Requests should also include the requester contact information and full name for the Ministry. The Part-II Order request should be sent in writing or by email to the following:

Minister
Ministry of the Environment, Conservation and Parks
777 Bay Street, College Park 5th Floor
Toronto, ON M7A 2J3
Phone: 416-314-6790
minister.mecp@ontario.ca

Copies of the request must also be sent to the Director of the Environmental Approvals Branch at the MECP and the Municipality of Brockton at the addresses below:

Director, Environmental Assessment and Permissions Branch
Ministry of the Environment, Conservation and Parks
135 St. Clair Avenue West, 1st Floor
Toronto, ON M4V 1P5
EABDirector@ontario.ca

Gregg Furtney, Director of Operations
Municipality of Brockton
100 Scott Street
P.O. Box 68, Walkerton, ON N0G 2V0
gfurtney@brockton.ca

The decision whether or not a Part II Order is appropriate or necessary rests with the Minister of the MECP. If a Part II Order request is not outstanding by the end of the 30 calendar day review period, the project is considered to have met the requirements of the Class EA, and the Municipality may proceed to design and construct the project subject to resolving any commitments documented in this Project File during the subsequent design phases and obtaining any other outstanding environmental approvals.

3. EXISTING CONDITIONS

3.1 Site Surroundings

Greenock structure No.0002 is located in the Hamlet of Riversdale, within the County of Bruce between the Walkerton and Kincardine, where shown on **Figure 1**. The bridge, which is situated on Bridge Street in Riversdale, crosses the Teeswater River at a location approximately 480 meters north of Provincial Highway 9, and can be accessed from the south via Union Street North and from the north using Sideroad 20 South (herein referred to as Sideroad 20S). A Site Plan is provided on **Figure 3**. More specifically, the bridge is situated centrally within Lot 30 Concession 1 North of Durham Road, in the former Township of Greenock. The Township of Greenock amalgamated with the Township of Brant and the Town of Walkerton in 1999, creating the Municipality of Brockton. The municipal boundary with the Municipality of South Bruce is situated approximately 1.5 kilometers south of the bridge location.

The primary land use in the area is rural and agricultural, with a more densely populated residential area located to the southwest within the Hamlet of Riversdale. The general area is designated as Hazard Lands and/or Environmental Protection, as defined by the Bruce County Official Plan (Schedule A, 2017) and the Municipality of Brockton Zoning By-Law (2013-26). The bridge and its surroundings fall within the Saugeen Valley Conservation Authority (SVCA) screening limits. The structure crosses the Teeswater River approximately 25 kilometers south of its confluence with the Saugeen River in Paisley.

The existing bridge is adjacent to unevaluated wetlands and is approximately 700 meters north of a portion of the Provincially Significant Greenock Swamp Wetland Complex. The topography of the area is relatively flat; consisting of the floodplains of both the Teeswater River and Greenock Creek. As shown in Photo 1, the abutments on each side of the bridge extend, to some degree, into the floodplain and the bridge spans between the road fills on either side of the Teeswater River. The main channel of the Teeswater River runs relatively straight under the bridge and is typically an estimated 20 meters wide in the vicinity of the structure. However, it is noted that the width of the river in this area can vary, becoming significantly greater during wet periods (such as the spring freshet) when the river rises and overflows into the surrounding floodplains.



Photo 1: Image showing the steel rivet-connected Pratt through-truss bridge.



Photo 2: View of the underside of the bridge superstructure and the abutment.

The area in the vicinity of the bridge is located on the northwestern edge of the physiographic region known as the Teeswater Drumlin Field (Chapman and Putnam, 1984) and borders the Horseshoe Moraines. The Teeswater Drumlin Field is generally characterized by drumlins, gravel terraces, kames and moraines comprised of glacial tills, with generally good drainage. However, the Greenock Swamp borders the Teeswater Drumlin Field to the northwest. The Greenock Swamp and surrounding land is characterized by silt and fine sand deposits with poor drainage. Consistent with this description, MECP water well records in the area indicate that the overburden in the area is approximately ± 20 meters thick and consists of clay/silt till deposits. The underlying bedrock is characterized by interbedded grey-brown limestone and dolostone of the Detroit River Group, which was deposited during the Middle Devonian period.

3.2 Road Approaches

Although Riversdale Bridge is a single lane structure oriented in an east \leftrightarrow west direction, both road approaches are narrow two-way roads within standard 66 ft (± 20 m) rights-of-way. From the Hamlet of Riversdale, the bridge is accessed from the south via Union Street North which connects to Bridge Street approximately 160 meters west of the subject bridge. Sideroad 20S, which is a rural gravel road, provides access from the north via a sharp turn in the road situated within ± 10 meters to the east of the bridge. The limited sight line for southbound traffic, associated with the sharp turn in close proximity to the one-lane structure, ultimately reduces driver safety (**Photo 4**).



Photo 3: View of the westerly approach to the structure.



Photo 4: View of the easterly approach showing the sharp turn on the east side.

3.3 Bridge Structure

The subject single-lane bridge was reportedly built in the early 1900's. The structure is an 8-panel rivet-connected Pratt through-truss bridge with steel floor beams and stringers supporting a laminated timber deck. Although it is not known how the existing structure is founded (i.e. piles or spread footings), the bridge is supported by cast-in-place concrete abutments and wingwalls with an overall span of 37.1 meters. The overall width of the existing structure is approximately 4.25m with flex beam guiderails on each side (refer to **Photo 4**). The flex beams are fastened directly to the steel truss. The available clear roadway width is approximately ± 4.0 meters which accommodates one lane of traffic. There are no deck drains.

To date, several repairs have been completed. More specifically, in 2003 the timber deck and steel stringers were removed and replaced with new steel stringers and pressure treated timber deck boards along the full length of the structure. In addition, some repairs were completed on the steel bridge trusses and a concrete cap was placed on the ballast wall. Further, in 2012 minor repairs were completed on the steel structure within an area of impact damage on the upper braces of the structure.

Recent inspections have observed the bridge, including the abutments and wingwalls, to be in overall fair to poor condition. Until recently, inspection reports supported the continued use of the structure, with a triple load posting of 8, 13, and 21 tonnes. Such a posting restricts the weights to three vehicle types: the first being a single-unit vehicle (also known as a straight truck), the second being a two-unit vehicle (also known as a tractor trailer), and the third being a vehicle train (also known as a tractor trailer with a pup, or B-train). However, the most recent inspection completed in April 2020 indicated that the floor beams below the deck are exhibiting severe corrosion and section loss, thereby significantly reducing the overall load carrying capacity of the bridge. As a result, it was recommended that the structure be removed or replaced within one-year. Further, the OSIM report recommended that the bridge be closed to all vehicular traffic in the interim. As such, the Municipality closed the bridge on June 1, 2020. Recent bridge inspection reports are included in **Appendix C**.

4. ALTERNATIVE SOLUTIONS

Alternative solutions considered to address the Project Statement are summarized as follows:

1. Do Nothing
2. Rehabilitate the Existing Bridge
- 3A. Replace the Existing Bridge with a Single-Lane Structure
- 3B. Replace the Existing Bridge with a Two-Lane Structure
4. Bridge Removal
5. Retention of Existing Structure Adapted for Walkways, Cycling and Scenic Viewing

A summary and discussion of each of these alternative solutions is presented in the following sections.

4.1 Do Nothing

The 'Do Nothing' alternative maintains existing conditions. It would not address the issues identified in the Project Statement but is considered as a base-line against which to compare other alternative solutions. The 'Do Nothing' alternative would permit the structure to remain in service until it can no longer perform its intended function. Until recently, a triple load posting of 8, 13 and 21 tonnes was recommended. This limited its usefulness as a route for emergency and agricultural vehicles. Due to its continued deterioration, the closure of the structure to vehicular traffic was recommended in the Spring of 2020 and the bridge was subsequently closed on June 1, 2020.

Leaving the bridge in its existing condition through winter seasons, without snow removal, could result in over 40 tonnes of snow accumulating on the deck (based on the ground snow load for Walkerton provided in the Ontario Building Code), roughly double the upper limit of the triple load posting. This could lead to a catastrophic failure of the bridge.

Ultimately, this approach would lead to a catastrophic failure, which is considered inappropriate and, therefore, consideration and a decision for action will be necessary moving forward. The 'Do Nothing' alternative may be implemented at any time during the planning process prior to implementation of the *Preferred Solution*.

4.2 Rehabilitate the Existing Bridge

Rehabilitation would entail completing repairs to the various elements of the existing substructure and superstructure that have been identified as deficient in order to extend the useful life of the bridge. As noted in the inspection reports, the steel superstructure displays considerable deterioration, including numerous secondary members which are permanently deformed. Further, the concrete substructure is in overall poor condition with '*severe to very severe cracking, spalling and delamination*'. As a result, it is anticipated that major repairs would be necessary to maintain the structure's functionality as a vehicular bridge and to extend its useful life by 10 to 20 years, if possible, at which time full replacement would be required.

4.3 Replace Existing Structure

This alternative, to replace the existing bridge at the existing location and grade, would involve the complete removal of the existing structure. Two replacement options could be considered including the following:

- Option 3A: Replacement with a single span, single lane bridge.
- Option 3B: Replacement with a single span, two-lane bridge.

The existing single lane bridge and the southbound road approach from Sideroad 20S, which includes a sharp turn in close proximity to the structure, does not meet the Ontario Provincial Standards for Roads and Public Works, nor the County or municipal standards. The replacement option could consider simultaneously improving the road approaches, as practicable.

4.4 Remove Existing Structure

This alternative considers that the existing single lane bridge carries a relatively small volume of traffic and, given the relatively long span of the structure, the relative costs of significant repairs or replacement could outweigh the relative benefits. Under this alternative, the bridge would be removed, and the road would be closed with turn-around opportunities provided at each side. Further, the river banks on both sides of the Teeswater River could be restored to a more natural condition, possibly with the removal of the fill that was placed to create the approaches to the bridge.

4.5 Retention of Existing Structure Adapted for Walkways, Cycling and Scenic Viewing

When bridge removal is considered an Alternative, the retention of a structure for the continued use of the bridge in-situ for non-vehicular use may be considered. This alternative considers that the closure of the bridge to vehicular traffic is imminent and that while the structure is no longer safe for vehicular use, the structure may be adapted for active transportation (i.e. walking and cycling) and viewing purposes. Adaptations to ensure the bridge meets the Standards/Design Code for walking and cycling purposes would be required (i.e. railings, barriers, etc.). As noted for the "Do Nothing" alternative, snow accumulation concerns would have to be addressed for this alternative.

4.6 Other Alternatives Initially Considered

Two other alternatives were considered, however were deemed not to be viable options. These alternatives included (i) replacement with a culvert-type structure; and (ii) bridge removal with the provision for an alternate route via the extension of Sideroad 20 to Highway 9 within the right-of-way along the east side of the Teeswater River.

4.6.1 Culvert -Type Crossing

The maintenance of a river crossing for vehicular use at this location only considers replacement with a bridge type structure. A culvert type crossing is not considered. Culverts, which are defined as structures that form an opening through the soil (i.e. reinforced concrete box culvert or corrugated steel pipe), may be considered for smaller waterways and short spans. As an alternative, for wider waterways, several culverts in series may be considered, however the hydraulic capacity would be greatly reduced. Consequently, upstream flooding and/or flooding over the road would be likely during high flows. Also, the natural river bed would be more significantly affected by any culvert and associated fill. Furthermore, as the fill could extend beyond the property limits, additional property acquisition could be required. Therefore, for mainly technical (span length of greater than 30m), land acquisition, and environmental reasons, a culvert type structure is not considered a reasonable alternative for the replacement of Bridge No.0002 and is not considered further herein.

4.6.2 Removal of Existing Structure and Extension of Side Road 20

This alternative considered that the existing single lane bridge carries a relatively small volume of traffic and, given the relatively long span of the structure, the relative costs of maintaining this water crossing could outweigh the relative benefits. Under this alternative, the bridge would be removed, and the road through Riversdale would be closed with a turn-around opportunity provided on the west side of the Teeswater River.

On the east side of the Teeswater River, Sideroad 20S would be extended southerly to intersect Highway 9. In this manner, a more direct connection between Riversdale and the agricultural area to the east of the river could be maintained without incurring the bridge replacement and maintenance costs. Lands for roughly 500m of new road allowance would have to be secured through negotiations with the current landowner. However, following initial consultations with the MTO and the Saugeen Valley Conservation Authority (SVCA) this alternative was deemed to be infeasible, primarily due to the following:

- As the new road would alter the floodplain to the east between Sideroad 20S and Highway 9, and the west side of the road bed would encroach into the Teeswater River bank, an application to the SVCA outlining the control of flooding, erosion, pollution and the conservation of land would need to be submitted and approved. Preliminary comments from the SVCA, dated April 18, 2018, recommended that the alternatives that contain extending Sideroad 20S not be included for further consideration.
- Per Ministry of Transportation (MTO) correspondence dated March 28, 2018, the MTO has indicated that it would not support an intersection at Sideroad 20S and Highway 9 due to the proximity of the intersection to the bridge structure on Highway 9, as well as intersection spacing (at Union Street and Moscow Sideroad). More specifically, an MTO permit would be required for new entrances on Provincial highways. Introducing a new intersection on Highway 9 for a realigned Sideroad 20S would require an MTO entrance permit, which requires conformance with the Standards set out in MTO's Highway Access Management Guidelines. The guidelines classify Highway 9 as a 2B Arterial, which requires a desired intersection spacing of 1600 meters and a minimum spacing of 800 meters. The intersection associated with the Sideroad 20S extension to Highway 9 would be situated approximately 235 meters east of Union Street and 780 meters west of Moscow Sideroad. Therefore, the location would not meet the MTO's minimum spacing requirement of 800 meters.

Therefore, while the extension of Sideroad 20S to Highway 9 was initially considered to be a potential alternative, based on the preliminary feedback from the MTO and SVCA, this alternative is not considered technically or environmentally feasible, and is not considered further herein. Pre-consultation correspondence pertaining to this alternative is provided in **Appendix B**.

4.6.3 Rehabilitate the Existing Structure: Minor Repairs

Minor repairs could be completed to extend the useful life of the bridge by a few years (i.e. estimated to be less than 5 years). This rehabilitation option would entail reinforcing several steel cross-beams and could be completed at a lower cost than the more significant rehabilitation alternative considered herein. However, such repairs would be relatively inconsequential as the load posting for the structure would still need to be reduced significantly, to an estimated 3 tonnes. In other words, the structure would be limited to standard vehicles such as compact cars, SUVs and pickup trucks. Further, the continued use of the structure would remain subject to the findings of routine bridge inspections. Given the age and condition of the structure, other deficiencies will likely arise within five years that will have to be rectified to keep the structure open.

Based on the Municipalities experience, removal of barriers used to prevent bridge usage following closure and the use of various structures by vehicles exceeding the posted limit have been evident. Due to the difficulty associated with enforcing restrictions, the continued misuse of structures that have reduced load limits or have been closed to vehicular traffic occurs. While the use of a structure by heavier vehicles may not cause immediate failure, this can weaken the structure over time, and could eventually result in catastrophic failure even under the permitted use (i.e. by vehicles that meet the posted load limit). As such, a significantly reduced load limit, without a means for enforcement, can expose the Municipality to liability and this alternative is not recommended. However, with direction of Council as the Road Authority, this alternative could be considered further. As previously indicated, it is anticipated that the minor repairs would only extend the structure's functionality as a vehicular bridge by a few years, at which time a decision to remove or replace the structure would still be required.

5. BACKGROUND STUDIES

The following background studies were prepared to inventory the technical, social, natural, cultural and economic 'environments', and to inform the impacts of alternative solutions. Copies of these background study reports are provided in the Appendices.

Appendix C

1. Bridge Inspection Reports (2016 and 2018). Lot 30 Concession 1N, Greenock Survey. Prepared by GM BluePlan Engineering.
2. Ontario Structure Inspection Manual (OSIM): Inspection Form (April 2020). Prepared by GM BluePlan Engineering.

Appendix D

Riversdale Bridge No. 2 EA Study – Transportation Impact Study. Brockton, Bruce County. Prepared by Paradigm Transportation Solutions Limited (Paradigm) (April 17, 2018).

Appendix E

1. Bridge No.0002 (Riversdale), Municipality of Brockton, Environmental Assessment. Natural Heritage – Existing Conditions. Prepared by Aboud & Associates Inc. (Aboud) (January 18, 2018).
2. Floodplain Analysis Report (DRAFT): Bridge No. 0002 and Sideroad 20, Village of Riversdale, Municipality of Brockton. Prepared by GMBP (February 2018).

Appendix F

1. Stage 1 Archaeological Assessment – Proposed Bridge Replacement or Upgrade: Part Lots 30 and 31, Concession 1 NDR, Geographic Township of Greenock. Municipality of Brockton. Prepared by Scarlett Janusas Archaeology Inc. (July 11, 2017).
2. Stage 2 Archaeological Assessment – Proposed Bridge Replacement or Upgrade: Part Lots 30 and 31, Concession 1 NDR, Geographic Township of Greenock. Municipality of Brockton. Prepared by Scarlett Janusas Archaeology Inc. (July 11, 2017).
3. Bridge Street (Bridge 0002) Riversdale – Cultural Heritage Evaluation Report and Preliminary Cultural Impact Assessment. Prepared by Scarlett Janusas Archaeology Inc. (July 20, 2017; Revised August 25, 2018).
4. Cultural Heritage Evaluation Report and Preliminary HIA (ADDENDUM) and Heritage Impact Assessment. Prepared by GMBP (October 2020)
5. Correspondence with the Municipal Heritage and Library Committee, Municipality of Brockton.

A summary discussion of the background information, including the findings for each study, is provided in the following sections.

6. INVENTORY OF ENVIRONMENTS

6.1 Technical Environment

6.1.1 Bridge Condition Assessment

The most recent bridge inspection was completed in April 2020. A copy of the OSIM Inspection Form is included in **Appendix C**. The assessment identified several deficiencies and concluded that the structure was in overall fair to poor condition. The steel superstructure was noted to have numerous secondary members that are permanently deformed and some floor beams below the deck exhibited severe corrosion and section loss. Further, the concrete substructure was noted to be in overall poor condition with severe to very severe cracking, spalling and delamination.

Until recently, inspection reports supported the continued use of the structure, with a triple load posting of 8, 13, and 21 tonnes. However, following the most recent inspection completed in April 2020, it was recommended that the overall load carrying capacity of the bridge should be reduced, or closure of the structure to vehicular traffic considered, due to the severe corrosion and section loss observed in the floor beams. Further, it was recommended that the structure be removed or replaced within one-year. The completion of major repairs to the structure was not recommended as it would only serve to delay the closure or complete replacement of the structure. As such, rehabilitation would not likely be financially beneficial to the Municipality. In consideration of the observed bridge condition, the Municipality opted to close the existing structure to vehicular traffic. Bridge closure occurred on June 1, 2020.

6.1.2 Road Approach Deficiencies

Although Riversdale Bridge is a single lane structure oriented in an east↔west direction, both road approaches are two-way roads within standard 66 ft (±20 m) rights-of-way. From the Hamlet of Riversdale, the bridge is accessed from the south via Union Street which connects to Bridge Street approximately 160 meters west of the subject bridge. Sideroad 20S provides access from the north via a rural gravel road situated approximately ±10 meters east of the bridge via a sharp turn in the road (refer to **Photo 4**). The limited sight line for southbound traffic approaching the one-lane bridge ultimately reduces driver safety.

The Transportation Association of Canada (TAC) Geometric Design Guide for Canadian Roads (June 2017) notes that for a given classification of road, *'cross section elements should desirably be the same everywhere'*. A situation to be avoided is the creation of incompatibilities between the road cross section and its horizontal and vertical alignments. However, it is recognized that sometimes a sudden change in cross section configuration is unavoidable (i.e. narrow bridges). The TAC further states that *'narrow bridges, where the width of the preceding section of road is not reduced, also represent an expectancy violation for the driver. This is especially true when the bridges are located on curves or dips, where they are difficult to perceive'*. In these circumstances, mitigation of the impact of the unexpected features (i.e. advanced signing to warn drivers) or, where possible, re-alignment of the road to eliminate the inconsistency would be expected. However, it is thought that the typical effects from the lack of horizontal alignment consistency and road cross section change to one-lane, primarily the increased collision potential, is less of a concern in an area where the road mainly services residents within the local rural community, since most drivers would be familiar with this inconsistency.

The TAC also outlines design speed requirements. Design speed is a speed selected as a basis to establish appropriate geometric design elements for a particular section of road and typically takes into consideration the *'character of the terrain, anticipated operating speed, adjacent land use (urban or rural) and the road classification system'*. Design elements include the horizontal and vertical alignment, elevation and sight distances. However, in areas where there are limitations on the design speed approach, such as limitations on the horizontal alignment, the *'design speed only applies to curves, not the tangents that connect those curves'*. Therefore, the maximum operating speed on a tangent, especially a long one, can often significantly exceed the design speed of the horizontal curves at either end of the tangent. In other words, the design speed along Sideroad 20S can be greater than the design speed of the horizontal curve situated immediately to the east of the structure.

Given the incompatibility associated with the horizontal alignment of the roads approaching the Riversdale Bridge and the road cross section (i.e. two-lane roads leading into single-lane bridge), and in consideration of the low volume of vehicles which is typically limited to local traffic, the implementation of traffic management measures would likely be sufficient to address these incompatibilities. For example, in addition to reduced speed postings, in recognition of the poor sight line associated with southbound vehicles entering the single-lane bridge, traffic could be appropriately managed by requiring that southbound vehicles from Sideroad 20S yield to the northbound traffic by way of posting the necessary signage.

Further, road profile improvements could be considered as part of future road works, after the bridge project direction is resolved. Some typical road design parameters are provided in **Appendix C**. Generally, the number and width of through lanes should be the same on the bridge deck as on the approach roadway. The usual minimum acceptable bridge cross section is 8.5m, to accommodate two-way traffic. However, provision of single-lane bridges may be permitted on very low-volume roadways in which the minimum width between curbs, railings or curb and railing should not be less than 5.0 meters. For the easterly road approach, an increased horizontal curve radius could form part of the solution. Realignment or widening of the road allowance, by way of acquiring lands from the adjacent landowner, would be required.

6.1.3 Sub-Surface Conditions

Available information including physiographic mapping and the local MECP water well records were referenced to consider sub-surface conditions. Well records document a unit of primarily clay and silt till extending to bedrock which is generally encountered at a depth of about ± 20 meters in the vicinity of the Riversdale Bridge. Therefore, the native soil deposits along the banks of the Teeswater River at the subject location may not be suitable to support conventional spread footings. As a result, a replacement structure may require that the bridge be supported on pile foundations driven to bedrock (which is at approximately ± 20 mbgs). Pile foundations add significantly to construction cost, relative to conventional spread footings. Additional geotechnical investigations would be required to verify the sub-surface soil, bedrock and groundwater conditions prior to design and construction.

6.1.4 Utilities and Services

There is no watermain, sanitary sewer, or storm sewer associated with the Riversdale Bridge. An overhead hydro corridor has been observed along Sideroad 20S, crossing the Teeswater River to the north of the bridge and continuing along Bridge Street. Any construction activities proposed near this corridor must take into account a minimum separation distance from overhead lines, usually 3 meters or more, depending on the voltage in the lines. In addition, other public utilities (i.e. gas, phone, etc.) may be present in the area. An inventory of the existing utilities that are proximal to, and/or incorporated into, the structure should be completed as part of the design phase.

6.2 Social Environment

6.2.1 Bridge Usage: Transportation Assessment

Until recently, the bridge had a triple load posting of 8, 13, and 21 tonnes which limited its economic value and its usefulness as a route for emergency and agricultural vehicles. However, with its continued deterioration, closure of the bridge to vehicular traffic was recommended in the spring of 2020. The Municipality effectively closed the structure to vehicular traffic via the use of barricades at either end of the structure in June 2020.

Based on traffic counts completed by Paradigm Transportation Solutions in March 2018, it is estimated that the Riversdale Bridge accommodates limited traffic volumes, with AM and PM peak hour traffic volumes observed to be 3 vehicles and 5 vehicles, respectively. In addition, an estimated 2 to 3 pedestrians were observed to be using the bridge as a walkway over an 8-hour period. Therefore, this water crossing between the Hamlet of Riversdale and the agricultural community directly east of the Teeswater River, is considered to accommodate a 'significantly' low volume of traffic. Similar to the sentiment expressed in Paradigm's Transportation Impact Assessment, provided in **Appendix D**, with these low traffic volumes, the justification for the need to maintain this river crossing for the local community may be difficult to establish. Considering the low volume of traffic that uses this road, the costs associated with maintaining a crossing at this location, including bridge replacement and ongoing maintenance, may outweigh the benefits.

6.2.2 Traffic Movement

The subject structure and road approaches (i.e. Bridge Street and Sideroad 20S) are not considered to be part of the primary transportation corridors in the area. The main traffic travelling through this area travels along Highway 9 (east \leftrightarrow west) and Bruce Road 20/Bruce Road 4 (south \leftrightarrow north). Bruce Road 20 runs parallel to Sideroad 20S and is situated approximately 2 kilometers to the east (**Figure 4**). As a result, in consideration of the low traffic volumes experienced, it is not anticipated that bridge closure, whether it be short-term (i.e. temporary closure or replacement) or long-term (i.e. bridge removal), will have a significant impact on the primary transportation network.

6.2.3 Local Impacts and Alternate Routes

The Riversdale Bridge connects the Hamlet to Sideroad 20S, including the rural agricultural community to the east of the Teeswater River. As shown in **Figure 4**, access to the bridge is essentially limited to the Concession Block formed by the two main roads including Provincial Highway 9 to the south and Bruce Road 20 to the east, with direct access to Sideroad 20S and the bridge provided via the Hamlet of Riversdale and Concession Road 2. All of these roads are maintained year-round.

In consideration of alternatives that restrict vehicular movement at this river crossing, regardless of low traffic volumes and the availability of alternate routes, road closure will have some impacts. As would be expected, residents living in proximity to the bridge, including those residing in the Hamlet of Riversdale, or on a connecting road (i.e. Sideroad 20S or Concession 2), will experience the greatest impacts to bridge closure including increased travel times and decreased accessibility. To assess the potential impacts, consideration was given to the number of properties potentially affected (i.e. residential dwellings) and the length of the alternate route(s).

There are two agricultural properties that front onto Sideroad 20, one non-residential property on the east side that includes Quonset hut and a property on the westerly side that includes a single-family dwelling (i.e. 95 Sideroad 20S). In addition, one 24.7-hectare (61 acre) property, that includes a residence in Riversdale (i.e. 30 Union Street North), is divided by the Teeswater River for which the subject bridge provides access to the parcel to the east. This easterly portion is primarily comprised of a wooded area and appears to include an estimated 2 acres of workable agricultural fields. Based on this preliminary assessment, it is likely that access to these agricultural properties along Sideroad 20S would be most significantly impacted by the closure of the bridge to vehicular traffic. It is further noted that there are an additional 7 single family dwellings that front onto Concession Road 2, where shown on **Figure 4**. The impacts from bridge closure would likely be less significant for residents along this Concession Road (as compared to residents on Sideroad 20S), particularly as the properties become increasingly proximal to the intersection with Bruce Road 20.

With the closure of the bridge, either for the short-term or longer-term, a resultant increase in travel distance would be expected for those potentially commuting between the Hamlet and the agricultural properties along Sideroad 20S. Travel distance, measured as the distance from 'central' Riversdale, not utilizing the bridge, to the most southerly extent of Sideroad 20S is approximately 8 km. Worst case scenario, this would be an equivalent travel time of less than 10 minutes. It is more likely that bridge closure would most directly affect those on Sideroad 20S and, to a lesser degree, residents along Concession Road 2. The one-way access to these properties from Bruce Road 20 could result in a slight increase in travel time, namely for those ultimately traveling in a westbound direction. However, the increase would not be greater than about 4 km, or about 5 minutes of travel time.

6.2.4 Emergency Services

At this time, the closure of the bridge to vehicular traffic prevents the use of the bridge by larger emergency vehicles. However, with respect to the alternatives to remove, rehabilitate or replace the structure, emergency vehicle usage and the potential additional travel time should be considered. An overview of the emergency services provided within the Municipality, including the location of the stations/departments, was completed, as is summarized below.

1. **Fire Protection Services:** Fire protection is provided by two departments within the Municipality including the Walkerton Fire Department and the Elmwood Fire Department. Fire protection agreements are also provided by the Town of Hanover and by the three fire departments operated by the Municipality of Arran-Elderslie, including one situated in Paisley.
2. **Police Services:** The Municipality of Brockton is serviced by the South Bruce detachment of the Ontario Provincial Police (OPP) in Kincardine. An additional OPP detachment is located in Walkerton.

3. **Paramedic Services:** Bruce County Paramedic Services provide access to ambulances for local residents. This service provides multiple ambulance stations throughout Bruce County with the most proximal stations located in Walkerton and Kincardine.

The locations for each of the emergency services available to residents within the Municipality are shown on **Figure 5**. Based on the locations of the various stations/departments, and the access to Sideroad 20S provided by Concession Road 2, the use of the Riversdale Bridge as an alternate route for emergency vehicles would not likely provide for significantly improved access or significantly decreased travel times for emergency vehicles.

6.2.5 Active Transportation

Adapting the bridge for non-vehicular purposes such as walking, cycling and scenic viewing assumes that there is community interest in the structure and that it has the potential to be considered as a destination and/or attraction. Therefore, should retaining the bridge for non-vehicular purposes be considered, the Municipality would need to weigh the level of community interest in the structure, or its potential to attract others to the community, relative to other factors (i.e. cost, naturalize river banks, etc.).

While the structure itself could be maintained for walking and cycling, there is not a nearby or adjacent trail system for the bridge to be integrated into. In essence, the structure and its environs would itself be limited to non-vehicular movements, however, access to the bridge would be by way of the existing road approaches. It is noted that under the existing conditions there is reportedly limited non-vehicular traffic that currently uses the Riversdale Bridge. As noted earlier in this report, without snow removal during the winter, significant weights of snow could accumulate on the deck. Significant reinforcement or regular snow removal activity would be required to make this a feasible alternative.

6.3 Natural Environment

6.3.1 Natural Heritage: Existing Conditions

A "Scoped Environmental Impact Study" (EIS) was completed by Aboud in January 2018 to characterize and document natural heritage features within the study area and assess potential impacts to natural heritage features. In consideration of the alternatives initially reviewed, the Study Area for this assessment encompassed the existing bridge and the area of the potential road alignment, which extended along the east side of the Teeswater River from the southerly extent of Sideroad 20S to Highway 9. A copy of the EIS Report is provided in **Appendix E**.

The existing bridge is adjacent to unevaluated wetlands, is approximately 700 meters north of a portion of the Provincially Significant Greenock Swamp Wetland Complex and is surrounded by annual row crop agriculture to the north, east and west. Based on feedback from the Ministry of Natural Resources and Forestry (MNRF) provided to Aboud, the Greenock Swamp is classified as a Life Science Area of Natural and Scientific Interest (ANSI) because of the large number of plant and animal species that inhabit it, and it is also an important source of timber and commercial fish. The wetland also serves as a headwater for many streams and drains into the Teeswater River.

The Existing Conditions Report outlined the following Site Constraints specific to the alternatives being considered herein (i.e. bridge rehabilitation, replacement and removal).

- i. Species at Risk: Evidence of barn swallows was observed on the underside of the existing structure. In addition, potential habitat for the common snapping turtle, which is listed as a species of Special Concern, was identified in the Study Area.
- ii. It was determined that no Significant Wildlife Habitat was present immediately adjacent to the existing bridge.
- iii. Vegetation: No federal or provincial Species at Risk (SARA or SARO) were found in the study area.
- iv. The Teeswater River is considered a cool/warm water system with known populations of smallmouth bass and northern pike.
- v. The study area includes Environmental Protection/Hazard Lands.

6.3.2 Potential Impacts and Recommended Mitigation Measures (Preliminary Assessment)

The Existing Conditions Report completed for the Riversdale Bridge by Aboud identified the significant species, features and ecological functions within the study area, including the area being considered for the extension of Sideroad 20S to Highway 9. However, the alternative to extend of Sideroad 20S is no longer being considered. Therefore, based on the findings and recommendations of the Scoped EIS for a similar bridge project in the area, a preliminary assessment of the potential impacts and measures to mitigate potential impacts to natural heritage features specific to the alternatives being considered herein (i.e. bridge rehabilitation, replacement and removal) are outlined below. It is noted that, depending on the alternative selected, additional investigations and review of mitigation measures may be required, to be completed by a qualified consultant, during the design phase and prior to implementation/construction.

Potential Impacts (Preliminary Assessment)

Preliminary impacts of the bridge alternatives being considered as well as generalized impacts from the construction of the bridge were assessed to determine their extent and potential mitigation measures. A previous assessment completed for a similar project was used as a guideline. A summary of some potential impacts, specific to bridge rehabilitation, replacement or removal, are as follows:

- i. Impacts would primarily involve the removal of trees, naturalized weedy herbaceous vegetation communities, site grading, impact to fish habitat, and wildlife disturbance.
- ii. Trees close to the bridge location may require an assessment of stability for the retained trees and may include some selective tree removal and pruning.
- iii. There may be opportunities in the study area for edge enhancement, restoration, invasive species management and compensation planting to mitigate and offset potential impacts.

Avoidance, Mitigation and Compensation Recommendations (Preliminary)

Preliminary recommendations specific to the natural heritage features are provided to ensure protection and maintenance of natural heritage features and function within and adjacent to the subject bridge. Through the implementation of various mitigation, restoration, and compensation measures, negative impacts to the natural heritage system could be minimized, or negated. A preliminary set of recommended measures, using previous assessments by Aboud for similar projects as a guideline, can generally be summarized as follows:

- i. As barn swallows are commonly found nesting under bridges in this area, the bridge may need to be checked for barn swallows prior to any activity.
- ii. Erosion and sediment control planning may need to be completed as part of the detailed design.
- iii. It is typically recommended that the area of construction disturbance be kept to a minimum, with works and the use of heavy equipment minimized and/or removed from sensitive areas and natural feature boundaries.

- iv. The implementation of comprehensive restoration and compensation measures within areas impacted could be considered. Further, all disturbed areas could be re-vegetated or restored with appropriate indigenous plants.
- v. Activities would need to be timed to avoid wildlife disturbance during critical life stages, as follows:
 - a. No in-water works are permitted from March 15 to July 15 (spring timing restrictions) as per DFO fisheries timing windows. Fall timing restrictions, typically October 1 to May 31, are not stipulated in the Existing Conditions Report for the Riversdale Bridge as fall spawning species were not specifically identified.
 - b. Avoid removal of trees and vegetation during the generalized breeding bird nesting period from April 1 to August 31. If removal of vegetation is to occur during the general nesting period, a nest search should be carried out by a skilled and experienced biologist.
 - c. Installation of Barn Swallow exclusion measures (e.g. netting) is recommended prior to the beginning of the generalized breeding bird nesting period (April 1).

Based on the natural heritage features (i.e. site constraints) identified, it is expected that through the implementation of various avoidance, mitigation and compensation measures, none of the project alternatives to repair, replace or remove Bridge No. 0002 (Greenock) would result in significant long-term negative impacts to the natural heritage features identified within and adjacent to the Riversdale Bridge. Further, the natural features within the study area could be protected, and potentially enhanced, using mitigative and restorative measures, which could provide for long-term positive effects on the natural heritage features within the study area. It is recommended that, depending on the alternative selected, the environmental impact assessment be updated by a qualified consultant to include a review of potential impacts and mitigation measures specific to the alternative selected.

6.3.3 Regulations and Requirements

Saugeen Valley Conservation Authority

The Study Area is located within the jurisdiction and Screening Limits of the Saugeen Valley Conservation Authority (SVCA) and is regulated under Ontario Regulation 169/06: Regulation and Development, Interference with Wetlands and Alterations to Shorelines and Watercourses. Under this regulation a permit will be required for building construction/redesign, site grading, and/or the temporary or permanent placing, dumping, or removal of materials from the Site. A permit would also be required for straightening, changing, diverting or in any way interfering with the river.

The existing bridge and potential bridge replacement meet the SVCA policy as it is considered Public Infrastructure. Public Infrastructure is permitted within water courses subject to being approved through an EA process and/or subject to the interference on the natural features and hydrologic and ecological functions of the watercourse being deemed acceptable by the SVCA.

The SVCA generally considers that a hydrology assessment is not required for any project alternative that would maintain, or improve upon, the existing hydrologic / hydraulic characteristics provided by the existing structure. A project alternative that would increase fill within the floodplain (i.e. replacement with a two-lane structure), or would further restrict flow, would affect site hydraulics. It is anticipated that the removal of the bridge, including the abutments and portions of the approaches within the floodplain, would result in improved flow and would have little or no impact on the hydrology of the watercourse or flood risk. Further, bridge rehabilitation or replacement would likely either maintain the existing flow conditions or could provide an opportunity to improve flow hydraulics (i.e. longer bridge span). Therefore, a detailed hydrogeological study and analysis of the hydrologic functions and anticipated changes to the watercourse will not likely be required.

Department of Fisheries and Oceans Canada (DFO)

The Teeswater River, and the fish within, are protected under the Federal Fisheries Act (1985). Section 35(1) of the Fisheries Act states that *'no person shall carry out any work or undertake activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or fish that support such a fishery'*. Therefore, as per the Fisheries Act, a DFO letter of authorization would be required for any project alternative that would cause serious harm to fish and/or result in a permanent alteration to fish habitat. Examples would include the use of culverts, a new centre pier to support a multi-span bridge and/or an encroachment of the bridge footing/abutment further into the river than presently exists. None of the alternatives considered for the Riversdale Bridge are expected to permanently impact fish habitat within the Teeswater River.

6.3.4 Flood Elevation Study

The SVCA had previously indicated that the effect on the floodplain of the Teeswater River be quantified by means of a backwater analysis for various storm events, including the Regional Storm. A *'Floodplain Analysis Report'* (Draft: February 2018) was completed by GMBP to inform the alternatives initially under consideration, including the extension of Sideroad 20S directly south to Highway 9, and to approximate the floodline elevations at the location of the Riversdale Bridge under the Regional storm event. The Flood Elevation Study is included in **Appendix E**.

Based on the available topographic contour mapping, the existing bridge deck is at an elevation of about 277.05 masl (or meters above sea level). In comparison, the Regional storm event water surface elevation was estimated to be 275.14 meters. The study concludes that, based on the preliminary backwater analysis, the alternatives initially considered would be feasible for implementation as surface water elevations would be expected to remain generally unchanged or negligibly increased from existing conditions. However, SVCA comments pertaining to the analysis, provided in correspondence dated April 18, 2018, note that floodwaters have been observed to be level with Sideroad 20S just east of the subject bridge.

As discussed in **Section 4.6.2**, following the SVCA review of the *Floodplain Analysis Report*, the SVCA recommended that the alternatives that include for the extension of Sideroad 20S to the south not be included for further consideration. As this sentiment was echoed by the Ministry of Transportation, the initially considered alternative to extend Sideroad 20S straight south to Highway 9 was not carried forward into the assessment of alternatives considered herein.

Based on correspondence received from the SVCA (dated October 11, 2017), the SVCA will have no objection to the proposed project if the replacement bridge will not change the constriction of the river flow at the subject location. If the bridge design conforms with existing parameters of the existing bridge, and the hydrology will not be altered, SVCA staff will not require a Hydrologic Assessment for review. Additionally, SVCA staff will not require an EIS for review for bridge replacement (similar to existing structure). If the plans for the bridge change substantially from the existing condition, or further restrict flow, an Engineered Hydrology Report will need to be provided for SVCA review.

6.3.5 Source Water Protection

Recent amendments to the EA Process require proponents to consider whether the project is located within a Source Water Protection Vulnerable Area and, if so, to document whether any project activities are a prescribed drinking water threat. As part of the EA process, this project was reviewed with respect to the requirements under the Clean Water Act, 2006. The study area is located within the Saugeen Valley Source Protection Area and falls under the Saugeen-Grey Sauble-Northern Bruce Peninsula Source Protection Plan. Based on the Saugeen, Grey Sauble and Northern Bruce Peninsula Source Protection Vulnerable Areas Mapping Application and a review of the Source Water Protection Area, the Study Area is bordered by a Significant Groundwater Recharge Area (SGRA) with a vulnerability score of 4 (based on a 10-point scale with 10 being considered high). The SVCA Risk Management Office was consulted via the Notice of Project Initiation. SVCA comments specific to Source Water Protection will be included in **Appendix E**. Based on previous consultation efforts associated with other projects in the area, it is not anticipated that Source Water Protection will be a significant issue for this project.

6.3.6 Climate Change

The natural environment also includes potential impacts of the project on Climate Change, and of Climate Change on the project. In consideration of the various factors associated with each alternative, including the potential to maintain reduced travel time for local residents and improve traffic safety with bridge replacement, which would result in reduced greenhouse gas emissions relative to removing the bridge crossing, or reduced construction efforts and on-going winter maintenance requirements associated with bridge removal, the bridge alternatives being reviewed will have an overall net neutral effect with respect to climate change. Further, any of the alternatives would, at minimum, maintain existing flow environments, and at best, reinstate the original higher hydraulic capacity to this stretch of the river. In consideration of the potential effects of climate change, specifically that precipitation events may become more severe and intense causing peak flows to increase, the potential increase in hydraulic capacity may be preferable for upstream lands.

6.4 Archaeological Study

In consideration of Section 1.3.1 of the 2011 Standards and Guidelines for Consultant Archaeologists (S&G) administered by the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI), which lists criteria that are indicative of archaeological potential, the study area meets the following criteria:

- The presence of water sources (i.e. the Teeswater River);
- Early historic transportation routes (i.e. the river and its environs); and
- Areas of early Euro-Canadian settlement (i.e. the Hamlet of Riversdale).

Scarlett Janusas Archaeology Inc. was retained to complete a Stage 1 and a Stage 2 Archaeological Assessment for Bridge No.0002. A copy of each report (July 11, 2017) is provided in **Appendix F**. The assessment was conducted under the S&G. In letters dated July 14, 2017 and September 8, 2017, the MHSTCI confirmed the entry of the Stage 1 and Stage 2 Assessment Reports into the Ontario Public Register of Archaeological Reports (**Appendix F**).

The Stage 1 work included a review of historical background information and concluded that the study area exhibits archaeological potential *'based on the study area abutting the Teeswater River, the early (mid-1850's) village of Riversdale; the use of the river by Indigenous populations for both transportation and resource exploitation. Areas of low potential include those of permanently wet areas, and the poor drainage of the area from mud, bottom land, and other poorly drained soils. Included in the area of low potential is Bridge Street, Sideroad 20 and the Bridge Structure impacting the environment. The bridge is also a potential indicator of early historic activities (bridge construction) in the area'*. As a result, Stage 2 investigation work was recommended.

The Stage 2 archaeological assessment of the study area was conducted on July 6th, 2017 using a test pitting methodology conducted at 5-meter intervals. The study area included the areas within 20 meters by 20 meters from each corner of the bridge. Of the study area, only 48% was subject to field testing, the remainder consisted of previously disturbed land (i.e. 4%), slopes in excess of 20-degrees (i.e. 27%) or was observed to be permanently wet (i.e. 21%). No potential archaeological sites were located during the Stage 2 assessment.

Based upon the background research of past and present conditions and the Stage 2 archaeological assessment, the following is recommended:

- There are no archaeological resources located within the study area and there is no requirement to conduct additional archaeological assessment; and
- Compliance legislation must be adhered to in the event of discovery of deeply buried cultural material or features.

6.5 Built Heritage Resource and Cultural Heritage Landscape Evaluation

Cultural Heritage assessments are required to satisfy Section 2(d) of the Planning Act which necessitates *'the conservation of features of significant architectural, cultural, historical, archeological or scientific interest'*. A Cultural Heritage Checklist was prepared for this project and is provided in **Appendix F**. This checklist identifies that, since the proposed project involves a bridge constructed before 1956, then a Cultural Heritage Evaluation Report (CHER) and a Heritage Impact Assessment (HIA) are to be completed.

CULTURAL HERITAGE ASSESSMENT

Scarlett Janusas Archaeology Inc. was retained to complete the CHER and a Preliminary HIA for the Riversdale Bridge. A copy of the Report (Revised August 25, 2018) is provided in **Appendix F**. An addendum to the report, which forms part of the CHER/HIA, is also included in **Appendix F**.

Based on a search of the of the municipal, provincial and federal registers, the Riversdale Bridge is not designated as being a property of cultural heritage value or interest. Alternatively, to determine the potential cultural heritage value of the subject bridge the "Criteria for Determining Cultural Heritage Value or Interest" set out in Ontario Regulation 9/06 under the Ontario Heritage Act (OHA), as amended in 2005, were used. The CHER evaluates the potential of a "property" to be designated under the Heritage Act, if it meets "one or more of the following criteria...":

1. *The property has design value or physical value because it,*
 - i. *is a rare, unique, representative or early example of a style, type, expression, material or construction method,*
 - ii. *displays a high degree of craftsmanship or artistic merit, or*
 - iii. *demonstrates a high degree of technical or scientific achievement.*
2. *The property has historical value or associative value because it,*
 - i. *has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community,*
 - ii. *yields, or has the potential to yield, information that contributes to an understanding of a community or culture, or*
 - iii. *demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community.*
3. *The property has contextual value because it,*
 - i. *is important in defining, maintaining, or supporting the character of an area,*
 - ii. *is physically, functionally, visually or historically linked to its surroundings, or*
 - iii. *is a landmark."*

The CHER identified that the bridge met several of the cultural heritage assessment criteria, as follows:

Design or Physical Value:

The bridge is representative of a single-span, 8-panel, rivet-connected Pratt through-truss bridge. Heritage attributes identified by SJAI, specific to the subject bridge include the following:

- i. Cast-in-place concrete abutments;
- ii. Steel, single span with 8-panel design;
- iii. Rivet-connected skeletal framework, including diagonal steel members and horizontal bracing; and
- iv. Timber deck beams (replaced in 2003).

At this time, the Riversdale Bridge is one of four remaining metal rivet-connected Pratt through-truss bridges in Bruce County. Other similar bridges within the County include the following:

1. Kolb Bridge (7-Panel):

This single-span bridge is situated approximately 35 km north of Riversdale, directly south of Port Elgin, in the Town of Saugeen Shores.

2. Watson's Bridge (7-Panel):

This bridge, which was repaired in 2015, is located approximately 20 km north-northwest of Riversdale along the Greenock-Elderslie Townline Road and is maintained by the County of Bruce. It crosses over the Teeswater River south of Paisley.

3. Old CR-3 Bridge (8-Panel):

This two-span Pratt through-truss bridge is reportedly noted for its '*high degree of historic integrity with no major alterations*' (Historic Bridges Webpage). It is located approximately 42 km north of Riversdale in the Municipality of Saugeen Shores. Although the bridge no longer supports vehicular traffic, it has been left in-situ for off-road and non-motorized use only and a new vehicular bridge was constructed nearby.

In addition, approximately 12 kilometres northeast of Riversdale, north of Chepstow, there remains a similar 8-panel Pratt through-truss bridge commonly referred to as the Concession Road 8 Bridge. However, while the majority of the metal truss bridges have riveted connections, the Concession 8 Bridge has pinned connections which are considered less common.

Preliminary investigations suggest that within the surrounding area, several other similar Pratt through-truss bridges remain including five (5) in Grey County, three (3) in Wellington County, two (2) in Huron County and one in Perth County.

Historical or Associative Value:

The Riversdale Bridge demonstrates the work or ideas of a builder (or designer/engineer) that may be significant to the community. The bridge was built by the Hunter Bridge & Boiler Company of Kincardine which was established in 1887 by the Hunter brothers. Alexander and Robert Hunter were reportedly born in Brant County (i.e. near Hamilton) in 1851 and 1846, respectively, and moved to Bruce County in 1856.

The bridge may have direct associations with a theme that may be significant to the community or may have the potential to yield information that contributes to the understanding of the community as it served as an early transportation route serving the local agricultural community.

Contextual Value

The bridge contributes to the landscape character of the area, emphasizing its function to serve as a conduit to areas on either side of the Teeswater River.

SUMMARY OF ASSESSMENT, POTENTIAL IMPACTS AND MITIGATION MEASURES

The structure was found to meet at least one of the criteria of O.Reg.9/06 under the OHA. Therefore, the CHER concluded that *“the bridge has been evaluated as having cultural heritage value and interest”*. As such, in June 2020 the Municipality requested that, in consideration of the potential removal or replacement of the structure, the Brockton Heritage and Library Committee review the CHER for Greenock Structure No.0002. Following the Heritage Committee meeting on September 14th, 2020, the committee indicated that they concurred with the mitigation measures proposed, namely Option 1; commemoration of the structure. This consultation correspondence is included in **Appendix F**.

A preliminary Heritage Impact Assessment (HIA) was included in the CHER, better to inform the alternatives considered in the EA process. The preliminary HIA identified where a project alternative may impact an identified cultural heritage resource and considered preliminary mitigation measures, to be considered in the context of the overall project planning process. In general, impacts to the Cultural Heritage environment are greater for alternatives that involve alterations to the existing bridge that are more pronounced.

The following nine conservation options/alternatives are arranged according to the level or degree of intervention from minimum to maximum. The conservation options are based on the Ontario Heritage Bridge Program (1991), which is reportedly regarded as current best practice for conserving heritage bridges in Ontario and ensures that heritage concerns, and appropriate mitigation options, are considered.

TABLE 1: Ontario Heritage Bridge Conservation Options

| Ranking | Option | Description |
|---------|-----------------------|---|
| 1 | Retain in Service | Retention of existing bridge and restoration of missing or deteriorated elements where physical or documentary evidence (e.g., photographs or drawings) can be used for their design. |
| 2 | | Retention of existing bridge with no major modifications undertaken. |
| 3 | | Retention of existing bridge with sympathetic modification. |
| 4 | | Retention of existing bridge with sympathetically designed new structure in proximity. |
| 5 | Retain for Other Uses | Retention of existing bridge no longer in use for vehicular purposes but adapted for pedestrian walkways, cycle paths, scenic viewing etc. |
| 7 | | Retain bridge as a heritage monument for viewing purposes only. |
| 6 | Relocation | Relocation of bridge to appropriate new site for continued use or adaptive re-use. |
| 8 | Replace or Remove | Replacement/removal of existing bridge with salvage elements/members of heritage bridge for incorporation into new structure for future conservation work or displays; |
| 9 | | Replacement/removal of existing bridge with full recording and documentation of the heritage bridge. |

In general, when the nature of the proposed works is such that adverse impacts are unavoidable (i.e. public safety, cost, etc.), it is necessary to implement management or mitigation strategies that alleviate the detrimental effects to cultural heritage resource, such as sympathetic modifications/design, documentation and/or commemoration strategies. Mitigation measures are intended to lessen (or negate) anticipated impacts to cultural heritage attributes identified.

With respect to the Riversdale Bridge, in consideration of the overall poor condition of the bridge, the completion of major repairs would only delay the closure of the structure. Further, in addition to safety concerns, bridge rehabilitation would be very expensive relative to the benefits provided to the Municipality. Therefore, since bridge rehabilitation is not considered a viable option, bridge removal is imminent. In consideration of bridge removal, and potential bridge replacement, the following mitigation measures were recommended for the Riversdale Bridge.

1. Commemoration:

The Municipality may consider the preparation of a historical plaque (or monument) to commemorate the cultural heritage associated with the Riversdale Bridge for installation at the Site. This option was deemed by the Brockton Heritage and Library Committee to appropriately address the cultural heritage.

2. Documentation:

The history of the Riverdale Bridge is contained within the CHER/HIA. No known original drawings of the structure have been located, however, general schematic drawings of rivet-connected Pratt through-truss bridges and photos of the existing structure are contained within the CHER/HIA. As a mitigation measure, it is recommended that the CHER/HIA (revised August 25, 2018), and other relevant reports, form the documentation for the Riversdale Bridge. Furthermore, the Municipality could consider depositing a hard copy or digital copy, as a single documentation report, at the Walkerton Branch of the Bruce County Public Library System and at the Bruce County Museum and Cultural Centre.

AND/OR

3. Salvage of Elements:

Salvage elements for incorporation into new structure, conservation and/or displays (latter could include heritage parks, museums etc.).

6.6 Economic Environment

6.6.1 Capital and Maintenance Costs

The economic environment considers relative construction costs and longer term operating and maintenance costs with respect to benefits to the economy. Typically, the 'Do-Nothing' option would be considered to have no capital cost and, therefore, would rank first in terms of the economic environment. However, in this scenario "no cost" would be unrealistic, ultimately, due to the deteriorated condition of the bridge which would eventually lead to bridge collapse (i.e. future clean-up and demolition costs).

Recent inspections of the Riversdale Bridge have noted several deficiencies leading to closure of the bridge. Based on preliminary cost estimates, it is anticipated that each of the alternatives considered would have a project value in the range of approximately \$300,000 to \$1.9M. Preliminary cost estimates are included in **Appendix C**. Based on the preceding discussions, relative construction values are considered in **Table 2** as follows:

TABLE 2 – Ranking of Relative Capital and Maintenance Costs

| Alternative | | Estimated Cost | Additional Considerations | Relative Ranking |
|-------------|--|--|--|------------------|
| 1 | Do Nothing | Minimal (with potentially high environmental clean-up costs) | Eventual bridge collapse | \$\$\$\$ |
| 2 | Bridge Rehabilitation | \$500,000 to \$1.0M | Eventual bridge removal or replacement | \$\$\$\$\$ |
| 3 | Bridge Replacement 3A: One-Lane Structure 3B: Two-Lane Structure | \$1,3M to 1,6M \$1,6M to \$1,9M | Operation and maintenance costs would be minimal | \$ |
| 4 | Bridge Removal | \$300,000 to \$400,000 | No further costs | \$ |
| 5 | Bridge Retention/Adaptation | \$300,000 to \$700,000 | Eventual bridge removal or replacement | \$\$\$ |

Based on the construction costs, bridge restoration costs would likely be greater than bridge removal, but less than bridge replacement. However, it is anticipated that bridge repairs, once completed, would only marginally extend the useful life of the structure, thereby only delaying the requirement for load postings, traffic restrictions, and eventual bridge closure.

It is noted that cost estimates provided herein were prepared with limited design details and are based on probable conditions affecting the project. Therefore, they are intended to reflect the approximate magnitude of the project costs. A more detailed assessment of overall project costs would be evaluated during the design phase. However, since project costs are anticipated to remain below \$2.4M, a Schedule 'B' EA approach remains appropriate for this project.

6.6.2 Cost Versus Usage

The Riversdale Bridge has been found to accommodate a 'significantly' low volume of traffic. As shown in **Figure 4**, this bridge essentially facilitates direct access between the Hamlet of Riversdale and the agricultural community directly east of the Teeswater River. Without the bridge, access to the agricultural area to the east would be limited to the use of Concession Road 2. Concession Road 2 and Sideroad 20S would become dead end roads, about 3 to 3.5 kilometers in length. As would be expected, residents living in proximity to the bridge, including those residing in the Hamlet of Riversdale, or on a connecting road (i.e. Sideroad 20S or Concession 2), would experience the greatest impacts from bridge closure. Motorists who are travelling from further afield would be much less affected by the closure, if affected at all.

Considering the low volume of traffic that uses this road, which is presumably primarily local traffic, it has been previously stated that the costs associated with maintaining a crossing at this location may outweigh the benefits. To demonstrate this reasoning, an assessment of the economic cost associated with bridge replacement using a simplistic approach is provided below. In essence, the cost per 'potentially affected household' is calculated by comparing the capital cost to replace the structure (i.e. 1.3M to 1.9M) to the number of local properties potentially affected (i.e. residential dwellings), which was determined by the approximate number of properties with residential dwellings in the general area. It is estimated that the 20 to 50 households represents approximately 30% to 80% of the 'potentially affected households' in the area as it is presumed that not all residents actually use the river crossing on a routine basis.

TABLE 3: Cost vs. Usage – Assessment of Cost per Potentially Affected Household

| Range | Capital Cost (\$) | Households ⁽³⁾ (#) | Cost (\$/Household) | |
|-------|-------------------|----------------------------------|---------------------|-----------------------|
| | | | Total | Annual ⁽¹⁾ |
| Lower | \$1.3M | 20 | \$65,000 | \$870 |
| | | 50 | \$26,000 | \$350 |
| Mid | \$1.6M | 20 | \$80,000 | \$1,070 |
| | | 50 | \$32,000 | \$430 |
| Upper | \$1.9M | 20 | \$95,000 | \$1,270 |
| | | 50 | \$38,000 | \$500 |

Notes:

- (1) Annual Costs assume a service life of 75 years.
- (2) Costs do not include bridge maintenance.
- (3) Provides that the bridge primarily facilitates access to one concession block, this analysis assumes the bridge is mainly used by local traffic.

Considering the relatively low volume of traffic that uses this road, the cost to the Municipality associated with maintaining a crossing at this location, assuming a 75 year service life, is estimated to be in the range of \$350 to \$1,270 annually per 'potentially affected household'. This is for capital costs alone and does not include the costs for bridge maintenance. Therefore, with the limited connectivity to the overall road network and the low traffic volumes primarily limited to local traffic, the justification for the need to maintain this river crossing for the local community from the perspective of the Municipality as an entire entity is difficult to establish.

7. ASSESSMENT AND EVALUATION OF ALTERNATIVES

The Municipal Class EA outlines a comprehensive planning process (illustrated in **Figure 2**) that provides a rational approach to consider the advantages and disadvantages of various alternatives and their trade-offs in order to determine a *Preferred Solution* to address an identified problem (or opportunity), as well as consultation with agencies, indigenous communities and directly affected stakeholders and the public throughout the process.

The EA for Bridge No.0002 is being completed to assess the various options for this bridge crossing. Since a 'Do Nothing' approach would result in continued bridge closure and would likely lead to a catastrophic failure, which is considered inappropriate, consideration and a decision for action will be necessary moving forward.

The background studies were prepared to help inform the impacts each alternative would have on each of the environments. The process toward the selection of a *Preliminary Recommended Solution* involves the following:

- i) Identification of the impacts and mitigating measures of an alternative solution on each environment;
- ii) An assessment of the degree of impact each alternative would have on each environment; and
- iii) An evaluation based on comparative analysis of the alternative which best addresses the Project Statement.

The following summarizes the impact and assessment of each of the alternative solutions on each of the environments by providing a relative ranking of the six alternatives (including the two bridge replacement alternatives 3A & 3B); numbered between 1 and 6, with 1 being the least favoured and 6 being the most favoured in each case. Ultimately, the alternative with the highest total ranking would be considered as the *Recommended Solution*.

7.1 Impact Assessment of Alternatives

The following **Table 4** presents a summary of the assessment of alternative solutions.

TABLE 4: ASSESSMENT OF ALTERNATIVES: RIVERSDALE BRIDGE

| | | Alternative 1 | Alternative 2 | Alternative 3A | Alternative 3B | Alternative 4 | Alternative 5 |
|-----------------|-----------------------------|--|--|--|---|--|--|
| Environment | | Do Nothing | Bridge Rehabilitation | Bridge Replacement with Single Lane Structure | Bridge Replacement with Two-Lane Structure | Bridge Removal | Bridge Retention and Adaptation |
| SOCIAL | | | | | | | |
| 1. | Type of Use | Similar to the existing conditions, vehicular access would continue to be prohibited. Pedestrian access would eventually be prohibited as the bridge continues to deteriorate. | Upon completion of significant repairs, vehicular traffic could continue to use this crossing. On-going bridge usage would be subject to future bridge inspection results. | In the long-term, would maintain the continued use of the bridge, with minimal disruption to the local vehicular movements along this low volume road. Some impacts to traffic movement would be expected during construction periods only. | | Similar to existing conditions, a vehicular crossing would no longer exist. In addition, pedestrian movements would not longer be possible. | Bridge supports traffic movements between the Hamlet of Riversdale and the agricultural community to the east of the Teeswater River. Therefore, the use of the bridge solely for non-vehicular purposes would continue to impact traffic movements for local residents. |
| 2. | Impacts to Traffic Patterns | The continued closure of the bridge to vehicles would impact traffic movements for local residents. | Would re-open the the bridge to vehicles along this low volume road. Traffic movements between Riversdale and the agricultural community to the east of the Teeswater River would be maintained, albeit in the short-term. | Would re-open the the bridge to vehicles along this low volume road. Traffic movements between Riversdale and the agricultural community to the east of the Teeswater River would be maintained for the long-term. | | Bridge supports traffic movements between Riversdale and Sideroad 20S. As a result, bridge removal would impact traffic movements for local residents. | Bridge supports traffic movements Riversdale and Sideroad 20S. Therefore, the use of the bridge solely for non-vehicular purposes would impact traffic movements for local residents. |
| 3. | Safety | Deteriorated condition of the bridge would lead to an eventual bridge collapse. | Bridge repairs would improve bridge safety in the short-term. However, on-going deterioration would lead to future safety concerns. Frequent repairs should be anticipated. Road approach issues would not be addressed. | 1. Would improve upon the existing condition and would maintain the crossing for the local residents. Would be subject to normal on-going bridge maintenance. 2. Safety concerns associated with the road approach to the east (i.e. sharp turn immediately east of the structure) would not likely be addressed. | 1. Would improve upon the existing condition and would maintain the crossing for the local residents. Would be subject to normal on-going bridge maintenance. 2. Safety concerns associated with the road approach to the east (i.e. sharp turn immediately east of the structure) may be, in part, addressed. | Removal of the sub-standard bridge would address the safety concerns related to the bridge condition and the road approach deficiency to the east of the structure (i.e. the sharp turn). | Preventing vehicular access to the structure would address the safety concerns. However, efforts to prevent vehicular traffic from using the bridge are often compromised (i.e. barriers are moved). |
| 4. | Non-Vehicular Uses | Access for pedestrians and cyclists could be maintained in the short-term. However, would eventually be prohibited as the bridge continued to deteriorate. | Bridge rehabilitation would maintain the one-lane structure for both vehicular and non-vehicular movements. However, safety would remain an issue. | Consideration for a separate walkway could improve public safety. Without a walkway, the safety associated with the lack of visibility resulting from the sharp turn immediately to the east of the structure would remain an issue. | | Cyclists and pedestrians would be required to use the alternate routes. Scenic viewing would be limited to the river banks. | The adaptation of the bridge would provide for a potentially shorter alternate route for pedestrians that would not include the use of the busier Provincial Highway and County Roads. This would be a safer alternative for non-vehicular traffic movements. |
| 5. | Emergency Access | Access to properties is not dependent uopn the maintenance of a crossing. Provisions to provide a turn-around area and/or appropriate signage may be considered. | | | | | |
| | Ranking | 1 | 4 | 5 | 6 | 3 | 2 |
| NATURAL | | | | | | | |
| 1. | Wildlife Disturbance | Pending 'collapse' could result in significant disturbance to the fish habitat. | Impacts could be mitigated through the avoidance of construction activities during critical life stages (i.e. timing windows). | | | | |
| 2. | Vegetation | Would not require the removal of trees or vegetation. However, works associated with bridge collapse would have a more significant impact than a planned approach. | The implementation of restoration measures (i.e. re-vegetation) would result in long-term positive effects on the natural heritage features within the areas impacted. | | | | |
| 3. | Site Grading | Would maintain existing conditions in the short-term. Potential bridge collapse could ultimately lead to compromised slope stability. | Would maintain existing conditions. | Provides opportunites for improved slope stability (i.e. edge enhancement). Bridge substructure could be maintained within existing footprint. | Provides opportunites for improved slope stability (i.e. edge enhancement). The bridge substructure would require an expanded footprint. | Provides opportunites for improved slope stability (i.e. edge enhancement). | Would maintain existing conditions. |
| 4. | Hydrology (i.e. flow) | Would maintain existings conditions. | Would maintain existing conditions. | Bridge design could consider provisions for improved flow hydraulics (decreased constriction at bridge). | | The removal of the substructure, with provisions for improved slope stability measures, would provide for better flow hydraulics. | Would maintain existing conditions. |
| | Ranking | 1 | 3 | 5 | 3 | 6 | 3 |
| CULTURAL | | | | | | | |
| 1. | Archaeological | The Stage 2 Archaeological Assessment concluded there are no archaeological resources in the vicinity | | | | | |
| 2. | Cultural Heritage | According to the Conservation Options, retaining the bridge is preferred. | According to the Conservation Options, bridge retention is preferred. However, alterations would be significant. Bridge restoration efforts could consider sympathetic repairs, as practicable. | Alterations to the existing structure would be greatest. The replacement bridge could be incorporate some sympathetic design features, as practicable. | | Removal of the bridge would have the greatest impact to the cultural heritage attributes and features identified. Mitigation measures such as the placement of a commemorative plaque could be considered. | According to the Conservation Options, retaining the bridge is preferred. Alterations to the existing structure would be minimal. Bridge restoration efforts could consider sympathetic repairs. |
| | Ranking | 5.5 | 4 | 2 | 2 | 2 | 5.5 |
| TECHNICAL | | | | | | | |
| 1. | Construction Methods | Limited works would be required. | In depth repairs may be necessary that involve difficult construction practices. Eventually, some repairs may not be economically viable due to age and design of original structure. | Modern construction methods could be used which would allow for more contractors to be qualified to complete the work. | | Bridge removal effort would be simple relative to rehabilitation and replacement options. Cul-de-sacs would be considered and would include for limited road works improvements. | Bridge upgraddes would be simple relative to rehabilitation and replacement options. Cul-de-sacs would be considered and would include for limited road works improvements. |
| 2. | Construction Efforts | Construction efforts would be minimal until such a time that the implementation of emergency measures are required. | Bridge rehabilitation would result in more frequent periodic closures for construction efforts and would only provide a short-term solution to the structural issues noted. Would eventually require removal or replacement. | Construction may be substantially longer relative to bridge rehabilitation. Overall, bridge replacement would provide a long-term solution to the issues noted. | | Limited construction efforts. | Minor upgrades, such as railings, would be required. Would eventually require removal or replacement. |
| 3. | Maintenance | Maintenance would be minimal. Without snow removal, snow accumulations could result in excessive loading and potential bridge failure. | On-going bridge monitoring and restoration efforts would be required. | Would result in less frequent periodic closures for maintenance. | | No long-term maintenance | On-going bridge inspection, monitoring and rehabilitation efforts would be required. Without snow removal, snow accumulations could result in excessive loading and potential bridge failure. |
| 4. | Structural Condition | The condition of the bridge is being addressed to avoid potential collapse, which would require the implementation of emergency measures to address damage to the natural environment. | It is anticipated that major repairs would be necessary to restore the bridge for vehicular use in the short-term only. | Bridge replacement would improve vehicular and pedestrain safety both in the short-term and long-term. On-going maintenance would be limited. | | Bridge removal would address the deteriorating condition of the bridge and avoid the potential for collapsing into the river. | Significant repairs and on-going maintenance would still be required to maintain this water crossing for non-vehicular purposes. |
| | Ranking | 2 | 1 | 4.5 | 4.5 | 6 | 3 |
| ECONOMIC | | | | | | | |
| 1. | Short-term 'capital' costs | Overall the least costly alternative in the short-term. | Costs to rehabilitate the bridge in the short-term will be less. On-going maintenance costs would be based on the level of rehabilitation and difficulty to complete repairs. It is anticipated that regular capital investments into repairs would still be required in the short-term. | Cost to replace the bridge with a one-lane structue is estimated to be in the range of 1.3M to 1.6M. | Cost to replace the bridge with a one-lane structue is estimated to be in the range of 1.6M to 1.9M. | With the exception of the Do Nothing alternative, bridge removal would be the least costly of the alternatives. Demolition costs are estimated to be in the range of \$300K to \$400K. | Costs to rehabilitate the bridge for pedestrian use would likely still be significant. On-going maintenance costs would vary. It is anticipated that regular capital investments into repairs would still be required in the short-term. |
| 2. | Long-term costs | Relative to bridge removal, the costs associated with bridge collapse (i.e. emergency work) are considered high. | Would require the expediture of smaller, more frequent amounts. Bridge removal or replacement costs would eventually need to be considered. | Costs associated with on-going bridge maintenance would be low. | | Reduced maintenance costs would be realized as the structure would no longer need to be maintained or inspected. | Costs associated with maintainance of the structure as a pedestrain bridge would be ongoing. Eventual bridge replacement or removal would only be delayed. |
| 3. | Structure Longevity | The Do Nothing approach would allow the structure to continually deteriorate and eventually collapse. Retaining the bridge would defer the decision to replace or remove the structure at a later date. This would be subject to another EA process. | Rehabilitation would extend the life cycle of the structure for a short period. Retaining the bridge would defer the decision to replace or remove the structure at a later date. This would be subject to another EA process. | Is assumed to have a service life of 75 years. | | No longer a structure that the Municipality has to maintain. | Adaptation would extend the life cycle of the structure. Retaining the bridge would defer the decision to replace or remove the structure at a later date. This would be subject to another EA process. |
| | Ranking | 3 | 1 | 5 | 4 | 6 | 2 |
| OVERALL RANKING | | 12.5 | 13 | 21.5 | 19.5 | 23 | 15.5 |

7.2 Preliminary Recommended Solution

Based on the results of the relative ranking presented in **Table 4**, Alternative 4, to Remove the Existing Bridge, is identified as the *Preliminary Recommended Solution*. As the Riversdale Bridge is considered to have Cultural Heritage value, and it is anticipated that costs associated with the 'alterations' (i.e. bridge removal) will be less than \$2.4 million, the removal of the structure is considered to be a Schedule 'B' activity under the Municipal Class Environmental Assessment Roads Project Schedule No.30.

Some of the key factors considered in the determination for this recommendation include, but are not limited to, the following:

1. The Riversdale Bridge is not considered to be an integral part of the Municipality's transportation system in that it does not contribute significantly to the efficient movement of personal, commercial and emergency vehicles through the area. Therefore, the indirect economic costs of a short-term or long-term closure are expected to be minimal, if any.
2. The need to remove or replace the structure is imminent. Bridge rehabilitation will only delay the need to address a more permanent solution.
3. Considering the relatively low volume of traffic that uses this local road, the costs associated with maintaining a crossing at this location, including replacement and ongoing maintenance, appear to outweigh the benefits.
4. The bridge facilitates access limited to one concession block. It mainly serves to connect the Hamlet of Riversdale to the agricultural community to the east of the Teeswater River. Removal of the structure will primarily impact the inhabitants along Sideroad 20S and to a lesser degree those residing in the Hamlet of Riversdale and along Concession Road 2.
5. In terms of travel distance and time, in the worst case scenario, the removal of this water crossing would result in an additional travel distance of ± 8 kilometres, or less than 10 minutes of travel time.
6. With bridge removal, access to all properties would still be maintained, therefore there is no apparent need to re-establish a vehicular crossing at this location.

The *Preliminary Recommended Solution* is circulated with this version of the Project File to the public, agencies, and Indigenous Communities for review and comment. Comments regarding the *Preliminary Recommended Solution* will be considered and presented in an updated Project File, which will present a *Recommended Preferred Solution*, for consideration and acceptance (or otherwise) by Council. The *Recommended Preferred Solution* may be different than the current *Preliminary Recommended Solution*, depending on comments received and new information that may come to light.

8. CONSULTATION

Consultation early in and throughout the process is a key feature of environmental assessment planning. Schedule 'B' Municipal Class EA processes have two mandatory points of contact; the Notice of Project Initiation (i.e. Consultation - Phase 2) and the Notice of Project Completion.

8.1 Notice of Project Initiation and Invitation to Virtual Public Information Centre

A *Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)* was prepared and first issued on October 22nd, 2020. The Notice included an invitation to a Virtual Public Information Centre, to be held on November 9th, 2020. A copy of the Notice is included in **Appendix A**. The Notice was advertised in the Hanover Post and the Walkerton Herald-Times on October 22 and October 29, 2020. The Notice was also mailed to property owners surrounding the Study Area on October 22, 2020. It is noted that while public notice typically requires that notices be mailed to the owners of all properties within and abutting the Study Area, an extended notification area was endorsed, as outlined on the Figure provided in **Appendix A**.

The Notice of Project Initiation invites the public, agencies and Indigenous Communities to review this version of the Project File (i.e. Version 1), which includes the background technical reports, and to provide comments regarding the *Preliminary Recommended Solution*. Comments received will be included in the Project File (Version 2), to be issued at a later date.

8.2 Consultations

8.2.1 Public Consultation

With the circulation of this version of the Schedule 'B' EA Project File, the public are invited to provide comments regarding the *Preliminary Recommended Solution*. Comments received will be summarized in this section. Upon receipt and review of all comments, the review of alternatives will be revisited, and any new information will be incorporated into the re-assessment of a *Recommended Preferred Solution*, for consideration and acceptance (or otherwise) by Council.

8.2.2 Agency and Indigenous Community Consultation

Agencies with a regulatory role that may require future permits/approvals, or may have a direct interest in the study, are to be contacted at each 'mandatory point of contact' required as part of the EA process to invite feedback. This version of the Schedule 'B' Project File was circulated to select key agencies and Indigenous Communities on October 22nd, 2020 to solicit comments and feedback, which will be incorporated into further assessment of a *Recommended Preferred Solution* for consideration and acceptance (or otherwise) by Council. A circulation list, including a complete list of those contacted and a summary of the project consultation efforts, is included in **Appendix A**.

9. NEXT STEPS

This version of the Project File is issued under Phase 2 Step 5, as the first mandatory point of public contact under the Municipal Class Environmental Assessment process. Next steps in the process include the following:

- i. The Project File is circulated to the public, agencies and Indigenous Communities.
- ii. During the consultation period, the Municipality will host a Public Information Centre (PIC) on November 9th, 2020 to discuss the study findings to date.
- iii. Comments will be received by the Project Team until November 23rd, 2020.
- iv. Any new information received will be incorporated into the Project File, and the assessment of alternatives and the *Recommended Solution* will be updated for Council to consider as a *Preferred Solution*.
- v. Upon acceptance (or otherwise) by Council of the *Preferred Solution*, a *Notice of Project Completion* will be advertised, advising participants of the outcome to the Schedule 'B' EA process.
- vi. A 30-day review period will follow the *Notice of Project Completion* date to permit the opportunity for any participant to provide comments or concerns to the Municipality. In addition, if concern(s) raised deal with aboriginal or treaty rights, a request may be made to the Minister of the MECP to enact Part II of the Act (i.e. a Part II Order), which would require additional study to verify the project direction.
- vii. Upon completion of the EA process, the project may proceed to design, additional studies (as required), approvals and construction.

212326
Greenock Bridge No. 0002
Schedule B EA



SCALE - N.T.S.
OCTOBER 2020

SITE LOCATION MAP

Lot 30, Concession 1N
Former Township of Greenock
Municipality of Brockton

Figure No. 1

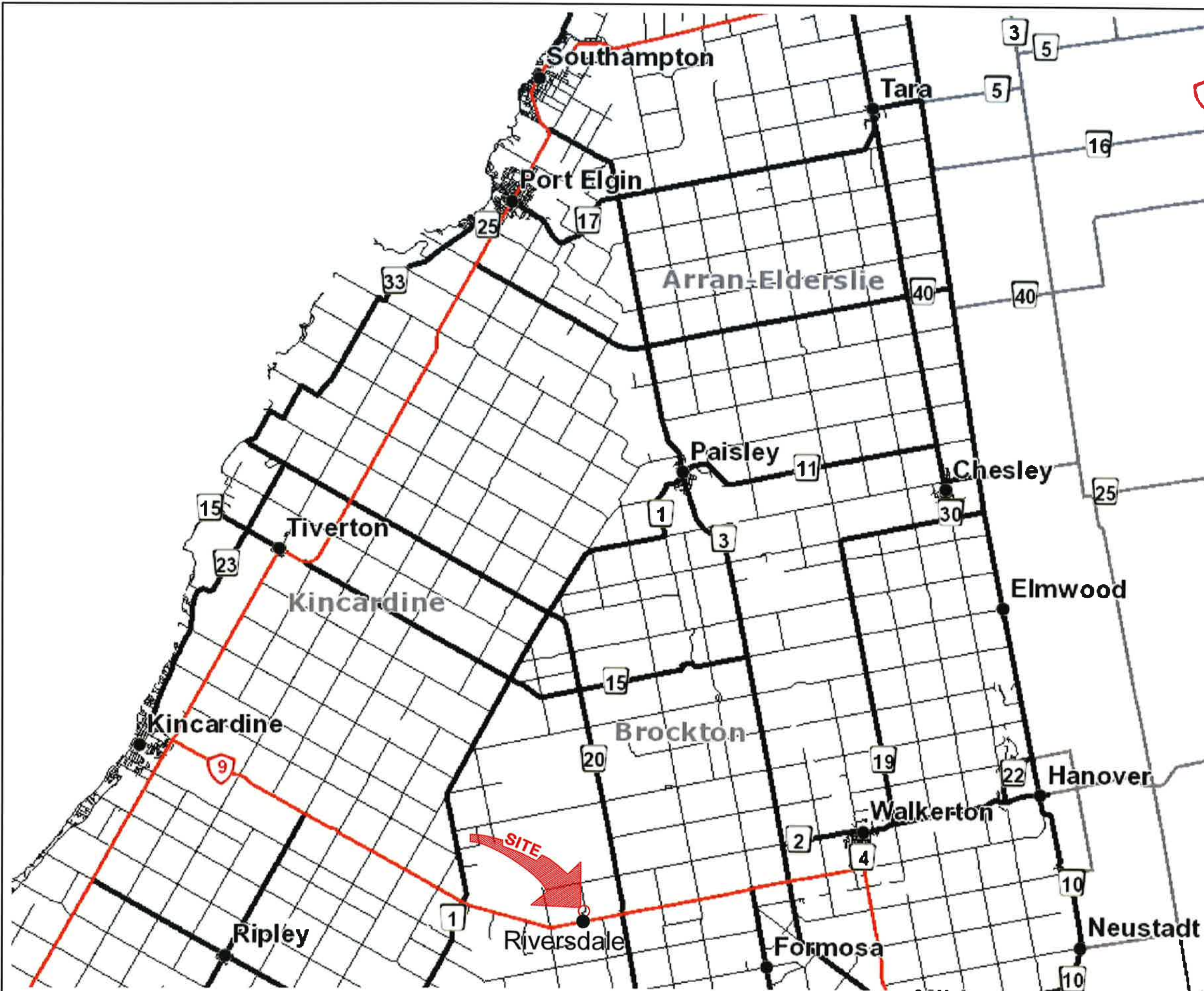
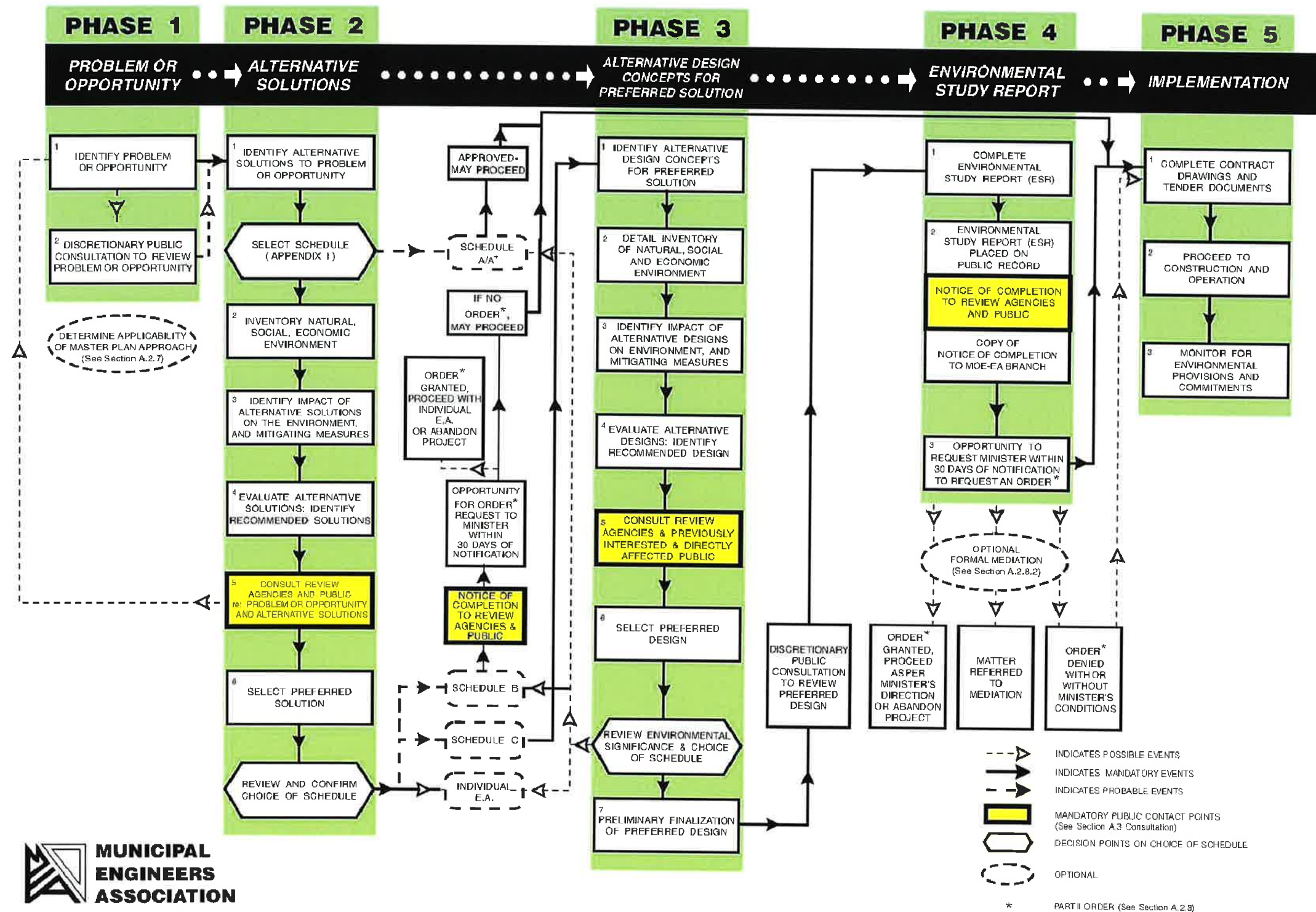


EXHIBIT A.2

MUNICIPAL CLASS EA PLANNING AND DESIGN PROCESS

NOTE: This flow chart is to be read in conjunction with Part A of the Municipal Class EA



SCALE - N.T.S.
OCTOBER 2020

EA PROCESS SCHEMATIC

Lot 30, Concession 1N
Former Township of Greenock
Municipality of Brockton

Figure No. 2

212326
Greenock Bridge No. 0002
Schedule B EA



SCALE - 1:4,000
OCTOBER 2020

SITE PLAN

Lot 30, Concession 1N
Former Township of Greenock
Municipality of Brockton

Figure No. 3








| | |
|---|--|
|  | ALTERNATE ROUTE-ALL SEASONS VIA BRUCE ROAD 20 AND HIGHWAY 9 |
|  | PARTIAL WINTER MAINTENANCE |
|  | NO WINTER MAINTENANCE |
| <i>[3564]</i> | CIVIC ADDRESS (RESIDENTIAL PROPERTY) |
| <i>[NR]</i> | NON-RESIDENTIAL PROPERTY |

LAND USE, IMPACTED PROPERTIES AND ALTERNATE ROUTES

Figure No. 4

Greenock Bridge No. 0002
Schedule B EA



-  FIRE DEPARTMENT
LOCATIONS
-  OPP STATION
LOCATIONS
-  PARAMEDIC STATION
LOCATIONS

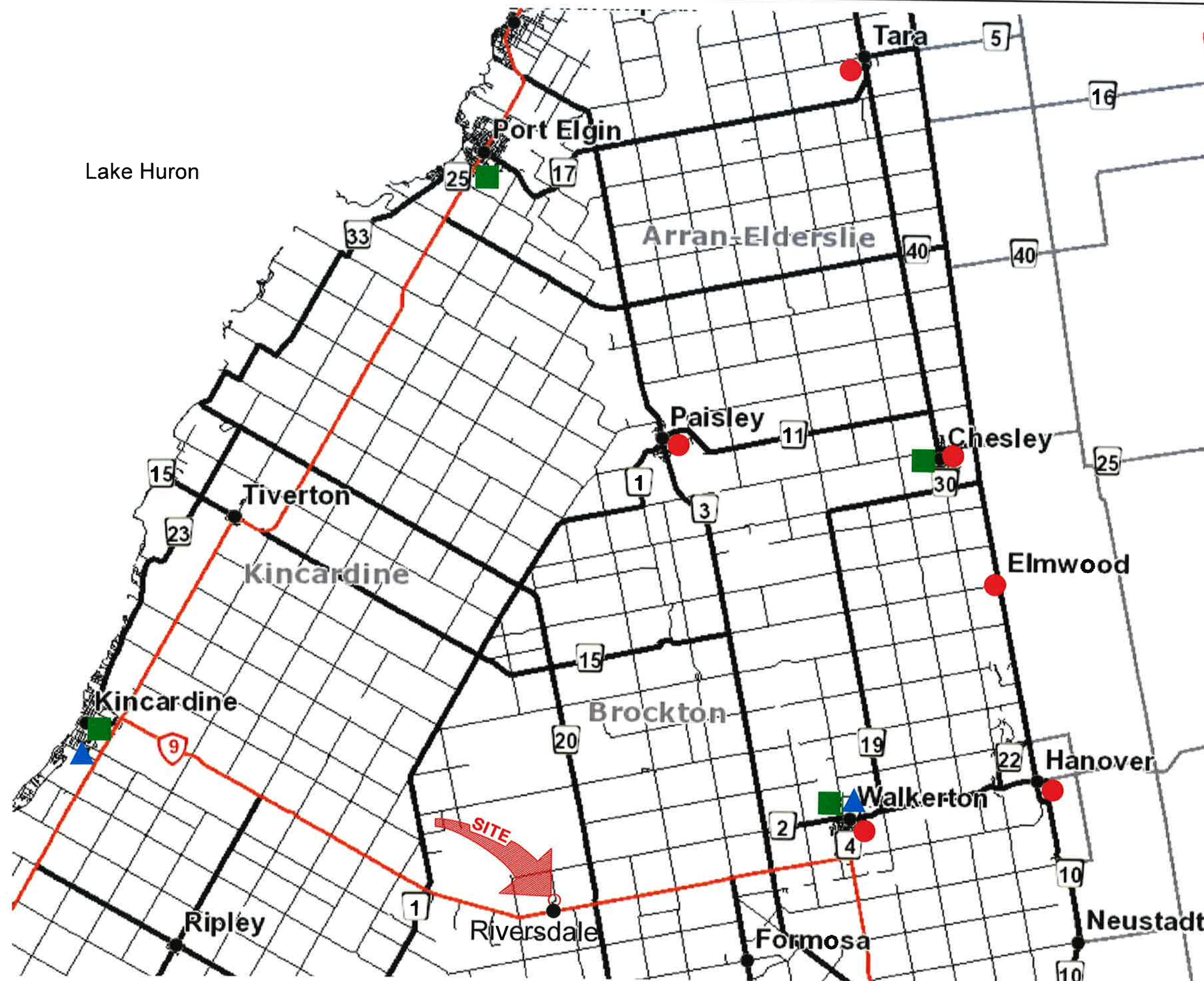
NOTE: LIMITED TO THOSE SERVICING
THE MUNICIPALITY OF BROCKTON

NOT TO SCALE
OCTOBER 2020

EMERGENCY SERVICES LOCATIONS

Lot 30, Concession 1N
Former Township of Greenock
Municipality of Brockton

Figure No. 5

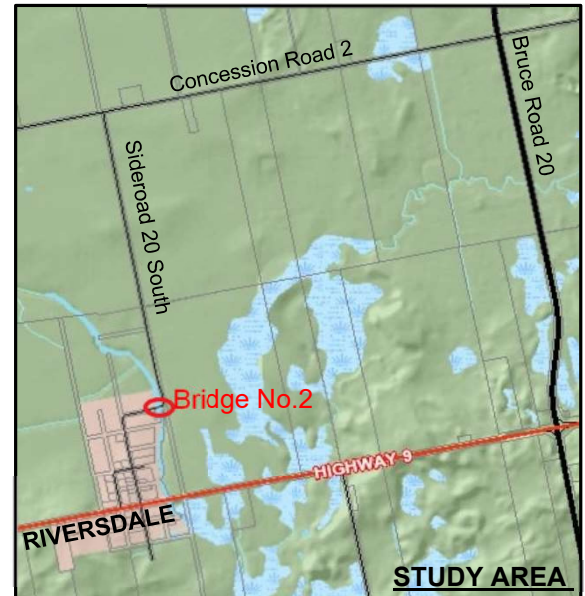


**APPENDIX A:
PROJECT NOTICES AND CIRCULATION**

NOTICE OF PROJECT INITIATION and
INVITATION TO VIRTUAL PUBLIC INFORMATION CENTRE (PIC No.1)

The Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Bridge No.2 (Greenock) on Bridge Street in Riversdale, just north of Highway 9, where shown on the Study Area map. The Municipality has identified advanced deterioration of the superstructure and substructure, including severe section loss in the floor beams and significant corrosion of the concrete and steel elements throughout. As a result, the bridge was recently closed to vehicular traffic. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class EA Manual prepared by the Municipal Engineers Association (2015). Alternative solutions that were considered for the structure included the following:

1. Do Nothing;
2. Rehabilitate the Existing Bridge;
- 3A Replacement with a Single-Lane Structure;
- 3B Replacement with a Two-Lane Structure;
4. Bridge Removal; and
5. Bridge Retention/Adaption.



Through the work completed to date, the Study Team has identified Bridge Removal as the *Preliminary Recommended Solution*. The Schedule 'B' Project File (Version 1), which includes all background technical reports, is available on the Municipality of Brockton website. Please note that this Notice is being circulated during the COVID-19 State of Emergency issued by the Province. As a result, in-person services are not available at this time. When in-person services are possible, the Project File will be made available at the Municipal Office for viewing purposes.

With the circulation of this Notice and the Project File, public, agency and Indigenous Community comments are invited for incorporation into the planning of this project. Written comments will be received by GM BluePlan Engineering and/or the Municipality until November 23rd, 2020. Contact information is provided below. Once comments are received, the Study Team will re-evaluate the *Recommended Solution* and present the findings in an updated Project File. Subject to the comments received, the verification of the *Preferred Solution* and the receipt of necessary approvals, the Municipality intends to proceed with the implementation of this project in 2021.

Public involvement is a key component of this project planning. The Municipality is hosting an EA Phase 2 Public Information Centre (PIC), which will include a brief presentation of the study process and findings, to receive input from interested parties. Due to COVID-19 restrictions, the meeting will be held virtually using Zoom video conferencing. Details of the PIC are as follows:

DATE: NOVEMBER 9th, 2020

TIME: 6:00 to 7:30 p.m.

EVENT DETAILS AND LINKS: Will be posted on the Municipality's website by clicking on the link provided within the 'Community Calendar' (<https://calendar.brockton.ca/default/Month>)

PUBLIC ENGAGEMENT OPTIONS:

WATCH: The PIC can be watched on Zoom and will also be livestreamed to the Municipality's YouTube Channel. A full recording of the PIC will subsequently be posted to the Municipality's YouTube Channel.

LISTEN: Dial in to a number provided on the Municipal website to listen to the meeting through Zoom Phone.

PARTICIPATE: If you wish to ask a question during the PIC, you are required to pre-register to be an attendee.

PRE-REGISTRATION by November 5th (11:30 pm) is required to participate.

Registered participants will receive an e-mail with further instructions and a link to join the Zoom meeting on November 6th. Following the presentation, you will be provided with an opportunity to speak to the project during the question and answer period.

You may register to participate (ask a question) in advance using the following link: <https://tinyurl.com/Bridge2-PIC>

COMMENTS: Written comments will be received until November 23rd. Contact information is provided below.

This Notice of *Project Initiation and Invitation to Virtual PIC* is advertised in the Hanover Post and the Walkerton Herald-Times and is also posted on the Municipality's website, where additional information is provided.

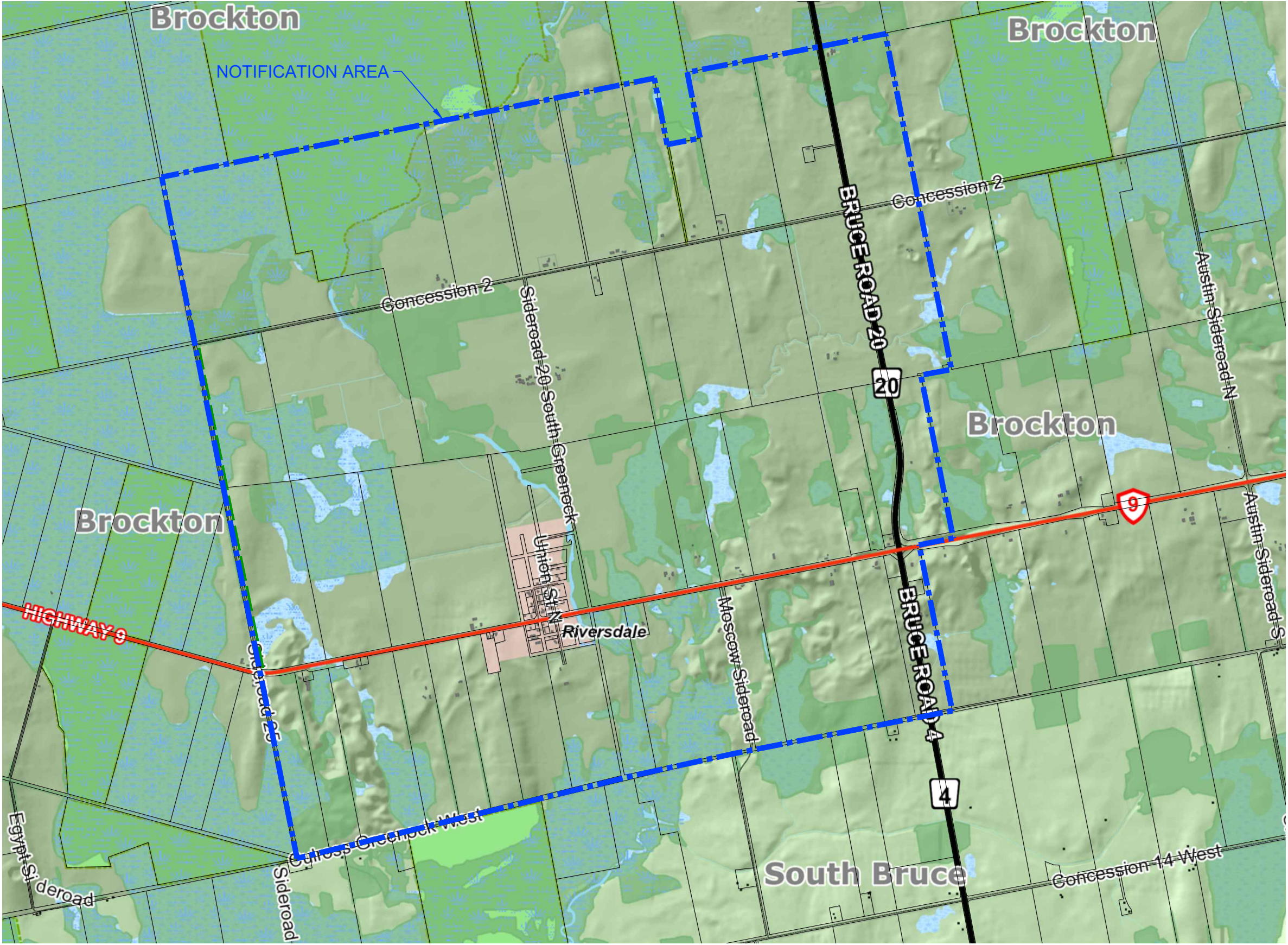
This Notice first issued on October 22, 2020.

Mr. Gregg Furtney, Director of Operations
Municipality of Brockton
100 Scott Street, P.O. Box 68
Walkerton, ON N0G 2V0
Tel: (519) 881-2223 Ext.134
gfurtney@brockton.ca
www.brockton.ca

Mr. Brent Willis, P.Eng., Project Manager
GM BluePlan Engineering Limited
1260 - 2nd Avenue East, Unit 1
Owen Sound, ON N4K 2J3
Tel: (519) 376-1805
brent.willis@gmblueplan.ca
www.gmblueplan.ca

****Please note that comments and opinions submitted will become part of the public record and may be viewed by the general public****

FILE:C:\Civil 3D Projects\212326 - Fig-tr.dwg LAYOUT:Notification Area
LAST SAVED BY:kboers, 5/5/2020 3:15:31 PM PLOTTED BY:Ken Boers - GM BluePlan 5/5/2020 3:19:11 PM



212326
Greenock Bridge No. 0002
Schedule B EA



LEGEND

--- LIMIT OF NOTIFICATION AREA

SCALE - 1:250,000
MAY 2020

NOTIFICATION AREA

Lot 30, Concession 1N
Former Township of Greenock
Municipality of Brockton

Figure A



CIRCULATION LIST: AGENCIES
BRIDGE No. 0002 (RIVERSDALE): SCHEDULE B EA

| AGENCY | | CONTACT INFORMATION | ADDRESS | DATE SENT or RECEIVED | INFORMATION SENT | | | | | | | DESCRIPTION | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|-----------|--|--|--------------------------|------------------|------|-------|--|--------------------|-------------------------|-------|-------------|---|
| | | | | | VIA | | | DOCUMENT (Incl. link to Project File) | | | | | |
| | | | | | E-mail | Mail | Phone | Notice (Initiation) | Notice (Update) | Notice of Completion | Other | | |
| MUNICIPAL AGENCIES | | | | | | | | | | | | | |
| County of Bruce | Contact | Kara Van Myall, Director | County of Bruce | 22-Oct-20 | S | | | | X | | | | |
| | | Planning and Development | Planning and Development | | | | | | | | | | |
| | Telephone | (519) 881-1782 | 30 Park St., P.O. Box 398 | | | | | | | | | | |
| | E-mail | KVanMyall@brucecounty.on.ca | Walkerton, ON N0G 2V0 | | | | | | | | | | |
| | Contact | | | | | | | | | | | | |
| County of Bruce | Contact | Miguel Pelletier | County of Bruce | 22-Oct-20 | S | | | | X | | | | |
| | | Director of Transportation | Walkerton Administration Centre | | | | | | | | | | |
| | Telephone | (519) 881-2400 | 30 Park St., P.O. Box 398 | | | | | | | | | | |
| | E-mail | mpelletier@brucecounty.on.ca | Walkerton, ON N0G 2V0 | | | | | | | | | | |
| | Contact | | | | | | | | | | | | |
| Municipality of South Bruce | Contact | Josh Fuller | Municipality of South Bruce | 22-Oct-20 | S | | | | X | | | | |
| | | Operations Manager | P.O. Box 540 | | | | | | | | | | |
| | Telephone | (519) 392-6623 | 21 Gordon St. E. | | | | | | | | | | |
| | Fax | (519) 392-6266 | Teeswater, ON N0G 2S0 | | | | | | | | | | |
| | E-mail | operationsmanager@southbruce.ca | | | | | | | | | | | |
| Municipality of Brockton | Contact | John Strader | Municipality of Brockton | | | | | | | | | | |
| | | Roads Superintendent | 100 Scott Street, Box 68 | | | | | | | | | | |
| | Telephone | (519) 881-2223 (Ext. 125) | Walkerton, ON N0G 2V0 | | | | | | | | | | |
| | Fax | (519) 881-2991 | | | | | | | | | | | |
| | E-mail | jstrader@brockton.ca | | | | | | | | | | | |
| Saugeen Valley Conservation Authority (SVCA) | Contact | Erik Downing | Saugeen Conservation | 22-Oct-20 | S | | | | X | | | | |
| | | Manager, Env. Planning and Regulations | 1078 Bruce Road 12 | | | | | | | | | | |
| | Telephone | (519) 367-3040 (Ext. 241) | P.O. Box 150 | | | | | | | | | | |
| | Fax | (519) 367-3041 | Formosa, ON N0G 1W0 | | | | | | | | | | |
| | E-mail | e.downing@svca.on.ca | | | | | | | | | | | |
| | Contact | Jamie Hagman | | | | | | | | | | | |
| | | Regulations Officer | | | | | | | | | | | |
| | Telephone | (519) 367-3040 (Ext. 224) | | | | | | | | | | | |
| | E-mail | j.hagman@svca.on.ca | | | | | | | | | | | |
| | Contact | Shaun Anthony | | | | | | | | | | | |
| | | Flood Warning and Water Quality Coordinator | | | | | | | | | | | |
| | Telephone | (519) 367-3040 (Ext. 239) | | | | | | | | | | | |
| | E-mail | s.anthony@svca.on.ca | | | | | | | | | | | |
| Source Water Protection | Contact | Carl Seider, Project Manager | Drinking Water Source Protection | 22-Oct-20 | S | | | | X | | | X | Source water consultation letter included |
| | Telephone | (519) 470-3000 (ext.201) | C/O Grey Sauble Conservation Authority | | | | | | | | | | |
| | Fax | (519) 470-3005 | R.R.#4; 237897 Inglis Falls Road | | | | | | | | | | |
| | E-mail | c.seider@waterprotection.ca | Owen Sound, ON N4K 5N6 | | | | | | | | | | |
| | E-mail | mail@waterprotection.ca | | | | | | | | | | | |
| Grey-Bruce Health Unit | Contact | Public Health Inspector | Grey Bruce Health Unit | 22-Oct-20 | S | | | | X | | | | |
| | Telephone | (519)376-9420 | 101-17th Street East, 3rd Floor | | | | | | | | | | |
| | Fax | (519)376-5043 | Owen Sound, ON N4K 0A5 | | | | | | | | | | |
| | E-mail | publichealth@publichealthgreybruce.on.ca | | | | | | | | | | | |

CIRCULATION LIST: AGENCIES
BRIDGE No. 0002 (RIVERSDALE): SCHEDULE B EA

| AGENCY | CONTACT INFORMATION | | ADDRESS | DATE SENT or RECEIVED | INFORMATION SENT | | | | | | | | DESCRIPTION | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|---------------------|--|---|--------------------------|------------------|------|-------|--|--------------------|-------------------------|-------|---|-------------|--|
| | | | | | VIA | | | DOCUMENT (Incl. link to Project File) | | | | | | |
| | | | | | E-mail | Mail | Phone | Notice (Initiation) | Notice (Update) | Notice of Completion | Other | | | |
| PROVINCIAL AGENCIES | | | | | | | | | | | | | | |
| Ministry of the Environment, Conservation and Parks Owen Sound Area Office | Contact | John Ritchie | MECP | 22-Oct-20 | S | | | | X | | | | | Services Grey, Bruce and Huron County |
| | | District Manager | Owen Sound Area Office | | | | | | | | | | | |
| | Telephone | (519) 377-1058 | 101 17th Street East, 3rd Floor | | | | | | | | | | | |
| | Fax | (519) 371-2905 | Owen Sound, ON N4K 0A5 | | | | | | | | | | | |
| | E-mail | John.S.Ritchie@ontario.ca | | | | | | | | | | | | |
| Ministry of the Environment, Conservation and Parks Southwestern Region | Contact | Regional Environmental Planner | MECP - Southwest Region | 22-Oct-20 | S | | | | X | | | | | Project Information Form Included |
| | Telephone | | Technical Support Section | | | | | | | | | | | |
| | Fax | (519) 873-5020 | 733 Exeter Road | | | | | | | | | | | |
| | E-mail | eanotification.swregion@ontario.ca | London, ON N6E 1L3 | | | | | | | | | | | |
| | Other | | | | | | | | | | | | | |
| Ministry of the Environment, Conservation and Parks Environmental Assessment and Approvals Branch | Contact | Director | MECP | 22-Oct-20 | S | | | | X | | | | | Project Information Form Included |
| | Telephone | (416) 314-7288 | Environmental Approvals Branch | | | | | | | | | | | |
| | Fax | (416) 314-8452 | 135 St, Clair Ave W, 1st Floor | | | | | | | | | | | |
| | E-mail | mea.notices.eaab@ontario.ca | Toronto, ON M4V 1P5 | | | | | | | | | | | |
| | E-mail | EAASIBgen@ontario.ca | | | | | | | | | | | | |
| Ministry of Natural Resources and Forestry | Contact | Jody Scheifley | Ministry on Natural Resources and Forestry | 22-Oct-20 | S | | | | X | | | | | Services Grey and Bruce County |
| | Telephone | (519) 371-8471 | Owen Sound Area Office | | | | | | | | | | | |
| | | (519) 372-3305 | 1450 7th Avenue East | | | | | | | | | | | |
| | E-mail | iodv.scheiflev@ontario.ca | Owen Sound, ON N4K 2Z1 | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Ministry of Natural Resources and Forestry | Contact | Ken Mott, District Planner | Ministry on Natural Resources and Forestry | 22-Oct-20 | S | | | | X | | | | | Services Grey and Bruce County |
| | Telephone | (705) 725-7546 | Midhurst District | | | | | | | | | | | |
| | | (705) 725-7584 | 2284 Nursery Road | | | | | | | | | | | |
| | E-mail | ken.mott@ontario.ca | Midhurst, ON L9X 1N8 | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| Ministry of Transportation | Contact | Steve Hood | 1450 7th Avenue East | 22-Oct-20 | S | | | | X | | | | | |
| | | Technical Services Supervisor | Owen Sound, ON N4K 2Z1 | | | | | | | | | | | |
| | Telephone | (519) 372-4036 | | | | | | | | | | | | |
| | E-mail | steve.hood@ontario.ca | | | | | | | | | | | | |
| Ministry of Agriculture, Food and Rural Affairs Regional Economic Development Branch (Grey/Bruce) | Contact | Carolyn Hamilton | Ministry of Agriculture, Food and Rural Affairs | 22-Oct-20 | S | | | | X | | | | | |
| | | Director, Rural Programs Branch | Rural Programs Branch, Ont Gov't Bldg | | | | | | | | | | | |
| | Telephone | (519) 826-3419 | 1 Stone Road West, 4th Floor NW | | | | | | | | | | | |
| | E-mail | carolyn.hamilton@ontario.ca | Guelph, ON N1G 4Y2 | | | | | | | | | | | |
| Ministry of Heritage, Sport, Tourism and Culture Industries Culture Division & Heritage Program Unit | Contact | Karla Barboza, Team Lead - Heritage (Acting) | MHSTCI | 22-Oct-20 | S | | | | X | | | X | | Addendum to CHER/HIA provided for review |
| | Telephone | (416) 314-7120 | 401 Bay Street | | | | | | | | | | | |
| | Fax | | Toronto, ON M7A 0A7 | | | | | | | | | | | |
| | E-mail | karla.barboza@ontario.ca | | | | | | | | | | | | |
| | Contact | Katherine Kirzati | | | | | | | | | | | | |
| | E-mail | katherine.kirzati@ontario.ca | | | | | | | | | | | | |

CIRCULATION LIST: AGENCIES
BRIDGE No. 0002 (RIVERSDALE): SCHEDULE B EA

| AGENCY | | CONTACT INFORMATION | ADDRESS | DATE SENT or RECEIVED | INFORMATION SENT | | | | | | | DESCRIPTION | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) |
|---|-----------|--|--|--------------------------|------------------|------|-------|--|--------------------|-------------------------|-------|-------------|--|
| | | | | | VIA | | | DOCUMENT (Incl. link to Project File) | | | | | |
| | | | | | E-mail | Mail | Phone | Notice (Initiation) | Notice (Update) | Notice of Completion | Other | | |
| FEDERAL AGENCIES | | | | | | | | | | | | | |
| Transport Canada | Contact | Regional Manager | Transport Canada | 22-Oct-20 | S | | | | X | | | | |
| | | Navigation Protection Program | Navigation Protection Program | | | | | | | | | | |
| | Telephone | (519) 383-1863 | Transport Canada, Marine Office | | | | | | | | | | |
| | Fax | (519) 383-1989 | 100 S Front Street, 1st Floor | | | | | | | | | | |
| | E-mail | EnviroOnt@tc.gc.ca | Sarnia, ON N7T 2M4 | | | | | | | | | | |
| | Contact | Benjamin Smith | | | | | | | | | | | |
| | | benjamin.smith@tc.gc.ca | | | | | | | | | | | |
| Environment and Climate Change Canada | Contact | Environmental Assessment Coordinator | Environment and Climate Change Canada | 22-Oct-20 | S | | | | X | | | | |
| | Telephone | (416) 739-4734 | Ontario Region | | | | | | | | | | |
| | Fax | (416) 739-4776 | 4905 Dufferin Street | | | | | | | | | | |
| | E-mail | ec.ecoactionon.ec@canada.ca | Toronto, Ontario M3H 5T4 | | | | | | | | | | |
| Indigenous and Northern Affairs Canada | Contact | Environmental Assessment Coordinator | Indigenous and Northern Affairs | 22-Oct-20 | S | | | | X | | | | |
| | Telephone | (416)973-4004 | Ontario Region | | | | | | | | | | |
| | Fax | (416) 954-6201 | 25 St Clair Ave East, 8th Floor | | | | | | | | | | |
| | E-mail | InfoPubs@aadnc-aandc.gc.ca | Toronto, Ontario M4T 1M2 | | | | | | | | | | |
| INDIGENOUS COMMUNITIES - Consultations (Mail) Completed by Municipality of Brockton | | | | | | | | | | | | | |
| Historic Saugeen Metis | Contact | Archie Indoe (President) | 204 High Street | 22-Oct-20 | S | | | | X | | | | |
| | | George Govier (Consultation Coordinator) | P.O. Box 1492 | | | | | | | | | | |
| | Telephone | (519) 483-4000 | Southampton, ON N0H 2L0 | | | | | | | | | | |
| | Contact | Chris Hachey | | | | | | | | | | | |
| | E-mail | hsmasstrcc@bmts.com | | | | | | | | | | | |
| | E-mail | saugeenmetisadmin@bmts.com | | | | | | | | | | | |
| Saugeen First Nation | Contact | Lester Anoquot (Chief) | Saugeen First Nation | 22-Oct-20 | S | | | | X | | | | |
| | | Cheree Urscheler (Band Administrator) | Chippewas of Saugeen First Nation No.29 | | | | | | | | | | |
| | Telephone | (800) 680-0744 | 6493 Highway 21, R.R.#1 | | | | | | | | | | |
| | Fax | (519) 797-2978 | Southampton, ON N0H 2L0 | | | | | | | | | | |
| | E-mail | cheree.urscheler@saugeen.org | | | | | | | | | | | |
| | E-mail | lester.anoquot@saugeen.org | | | | | | | | | | | |
| Metis Nation of Ontario (MNO) Great Lakes Metis Council Owen Sound Office | Contact | James Wagar | Metis Nation of Ontario | 22-Oct-20 | S | | | | X | | | | |
| | | Consultation Assessment Coordinator | Owen Sound Office | | | | | | | | | | |
| | Telephone | (519) 370-0435 | 380-9th Street East | | | | | | | | | | |
| | E-mail | jamesw@metisnation.org | Owen Sound, ON N4K 1P1 | | | | | | | | | | |
| | E-mail | joannem@metisnation.ca | | | | | | | | | | | |
| | E-mail | consultations@metisnation.org | | | | | | | | | | | |
| Saugeen Ojibway Nation Environmental Office | Contact | Juanita Meekins | Saugeen Ojibway Nation | 22-Oct-20 | S | | | | X | | | | Juanita has taken place of Doran Ritchie in the interim. |
| | | Saugeen Ojibway Nation, Environmental Office | Environment Office | | | | | | | | | | |
| | Telephone | (519) 534-5507 | 25 Maadookii Road | | | | | | | | | | |
| | Fax | (519) 534-5525 | Neyaashiinigmiing, ON N0H 2T0 | | | | | | | | | | |
| | E-mail | juanita.meekins@saugeenojibwaynation.ca | | | | | | | | | | | |
| Chippewas of Nawash Unceded First Nation | Contact | Chief Gregory Nadijwon | Chippewas of Nawash Unceded First Nation | 22-Oct-20 | S | | | | X | | | | |
| | Telephone | (519) 534-1689 | Administration Building | | | | | | | | | | |
| | Fax | (519) 534-2130 | #135 Lakeshore Blvd. | | | | | | | | | | |
| | E-mail | chiefsdesk@nawash.ca | Neyaashiinigmiing, ON N0H 2T0 | | | | | | | | | | |
| | E-mail | cnadministrator@nawash.ca | | | | | | | | | | | |

CIRCULATION LIST: AGENCIES
BRIDGE No. 0002 (RIVERSDALE): SCHEDULE B EA

| AGENCY | CONTACT INFORMATION | | ADDRESS | INFORMATION SENT | | | | | | | | COMMENTS/RESPONSE RECEIVED (DESCRIPTION) | |
|-------------------------|---------------------|--|-------------------------------|--------------------------|--------|------|-------|--|--------------------|-------------------------|-------|--|-------------|
| | | | | DATE SENT or RECEIVED | VIA | | | DOCUMENT (Incl. link to Project File) | | | | | DESCRIPTION |
| | | | | | E-mail | Mail | Phone | Notice (Initiation) | Notice (Update) | Notice of Completion | Other | | |
| UTILITIES | | | | | | | | | | | | | |
| Bell Access Network | Contact | Nicolas Kellar | Bell Access Network | 22-Oct-20 | S | | | X | | | | | |
| | Telephone | (519) 371-5450 | 870-4th Avenue East | | | | | | | | | | |
| | Fax | (519) 376-3563 | Owen Sound, ON | | | | | | | | | | |
| | E-mail | nicholas.kellar@bell.ca | N4K 2N7 | | | | | | | | | | |
| Bruce Telecom (BMTS) | Contact | Head Office | BMTS - Tiverton - Head Office | 22-Oct-20 | S | | | X | | | | | |
| | Telephone | (519) 368-2000 | 3145 Highway 21 | | | | | | | | | | |
| | Fax | | P.O. Box 80 | | | | | | | | | | |
| | E-mail | admin@brucetelecom.com | Tiverton, ON N0G 2T0 | | | | | | | | | | |
| Union Gas Limited | Contact | Kevin Schimus | Union Gas | 22-Oct-20 | S | | | X | | | | | |
| | Telephone | (519) 377-0214 | 603 Krumpf Drive | | | | | | | | | | |
| | Fax | (519) 376-2591 | P.O. Box 340 | | | | | | | | | | |
| | E-mail | kschimus@uniongas.com | Waterloo, ON N2J 4A4 | | | | | | | | | | |
| Hydro One Networks Inc. | Contact | Ken Aarup - Kevin Brackley | Hydro One Networks Inc. | 22-Oct-20 | S | | | X | | | | | |
| | Telephone | (888) 664-9376 | 45 Sargeant Drive, Box 6700 | | | | | | | | | | |
| | Fax | (905) 944-3251 | Barrie, ON | | | | | | | | | | |
| | E-mail | Zone5PlanningDept@HydroOne.com | L4N 4V9 | | | | | | | | | | |
| | cc. | kevin.brackley@hydroone.com | | | | | | | | | | | |
| Rogers Cable | Contact | Tony Dominguez | Rogers Cable | 22-Oct-20 | S | | | X | | | | | |
| | Telephone | (705) 737-4660 ext. 6923 | 1 Sperling Drive | | | | | | | | | | |
| | Fax | (705) 737-3840 | Barrie, ON L4M 6B8 | | | | | | | | | | |
| | E-mail | Tony.Dominguez@rci.rogers.com | | | | | | | | | | | |



October 22, 2020

Historic Saugeen Métis
204 High Street
P.O. Box 1492
Southampton, ON N0H 2L0

Attention: George Govier, Consultation Coordinator

**RE: Riversdale Bridge (Greenock Structure No.0002)
Schedule 'B' Environmental Assessment
Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)**

I am writing to notify you that the Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Greenock Structure No.0002 (i.e. the Riversdale Bridge) situated immediately north of Highway 9, between Kincardine and Walkerton, where shown on the attached map. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class Environmental Assessment Manual prepared by the Municipal Engineers Association (2015).

We are providing you with the attached *Notice of Project Initiation and Invitation to PIC No.1* for the Schedule 'B' EA, issued on October 22nd, 2020. The Schedule 'B' Project File (Version 1), which includes background technical reports, is available on the Municipality's website for viewing purposes. A Stage 1 and 2 Archaeological Assessment was completed for the study area in July 2017 and the cultural heritage evaluation was completed in August 2018.

Prior to proceeding with this project, we would like to know if you or your community have any questions or concerns regarding possible impacts to Aboriginal rights or title or if there are any other concerns with regard to the proposed project. Furthermore, should you require additional information, please contact the undersigned by telephone at (519) 881-2223 (ext.134) or by e-mail at gfurtney@brockton.ca. I would appreciate hearing back from you by November 23rd, 2020. If it is not possible to respond within this timeframe, please contact me to establish a mutually agreed upon timeframe. We will continue to provide updates as this project progresses.

I would like to thank you in advance for your consideration to this request and look forward to hearing back from you.

Yours truly,

Gregg Furtney, Director of Operations
Municipality of Brockton

Encl.

cc: Brent Willis, P.Eng., GM BluePlan Engineering



October 22, 2020

Métis Nation of Ontario
Great Lakes Métis Council
380 – 9th Street East
Owen Sound, ON N4K 1P1

Attention: James Wagar, Consultation Assessment Coordinator

**RE: Riversdale Bridge (Greenock Structure No.0002)
Schedule 'B' Environmental Assessment
Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)**

I am writing to notify you that the Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Greenock Structure No.0002 (i.e. the Riversdale Bridge) situated immediately north of Highway 9, between Kincardine and Walkerton, where shown on the attached map. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class Environmental Assessment Manual prepared by the Municipal Engineers Association (2015).

We are providing you with the attached *Notice of Project Initiation and Invitation to PIC No.1* for the Schedule 'B' EA, issued on October 22nd, 2020. The Schedule 'B' Project File (Version 1), which includes background technical reports, is available on the Municipality's website for viewing purposes. A Stage 1 and 2 Archaeological Assessment was completed for the study area in July 2017 and the cultural heritage evaluation was completed in August 2018.

Prior to proceeding with this project, we would like to know if you or your community have any questions or concerns regarding possible impacts to Aboriginal rights or title or if there are any other concerns with regard to the proposed project. Furthermore, should you require additional information, please contact the undersigned by telephone at (519) 881-2223 (ext.134) or by e-mail at gfurtney@brockton.ca. I would appreciate hearing back from you by November 23rd, 2020. If it is not possible to respond within this timeframe, please contact me to establish a mutually agreed upon timeframe. We will continue to provide updates as this project progresses.

I would like to thank you in advance for your consideration to this request and look forward to hearing back from you.

Yours truly,

Gregg Furtney, Director of Operations
Municipality of Brockton

Encl.

cc: Brent Willis, P.Eng., GM BluePlan Engineering



October 22, 2020

Métis Nation of Ontario

**RE: Riversdale Bridge (Greenock Structure No.0002)
Schedule 'B' Environmental Assessment
Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)**

I am writing to notify you that the Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Greenock Structure No.0002 (i.e. the Riversdale Bridge) situated immediately north of Highway 9, between Kincardine and Walkerton, where shown on the attached map. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class Environmental Assessment Manual prepared by the Municipal Engineers Association (2015).

We are providing you with the attached *Notice of Project Initiation and Invitation to PIC No.1* for the Schedule 'B' EA, issued on October 22nd, 2020. The Schedule 'B' Project File (Version 1), which includes background technical reports, is available on the Municipality's website for viewing purposes. A Stage 1 and 2 Archaeological Assessment was completed for the study area in July 2017 and the cultural heritage evaluation was completed in August 2018.

Prior to proceeding with this project, we would like to know if you or your community have any questions or concerns regarding possible impacts to Aboriginal rights or title or if there are any other concerns with regard to the proposed project. Furthermore, should you require additional information, please contact the undersigned by telephone at (519) 881-2223 (ext.134) or by e-mail at gfurtney@brockton.ca. I would appreciate hearing back from you by November 23rd, 2020. If it is not possible to respond within this timeframe, please contact me to establish a mutually agreed upon timeframe. We will continue to provide updates as this project progresses.

I would like to thank you in advance for your consideration to this request and look forward to hearing back from you.

Yours truly,

Gregg Furtney, Director of Operations
Municipality of Brockton

Encl.

cc: Brent Willis, P.Eng., GM BluePlan Engineering



October 22, 2020

Chippewas of Nawash Unceded First Nation
Administration Building
135 Lakeshore Boulevard
Neyaashiinigmiing, ON N0H 2T0

Attention: Chief Gregory Nadjiwon

**RE: Riversdale Bridge (Greenock Structure No.0002)
Schedule 'B' Environmental Assessment
Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)**

I am writing to notify you that the Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Greenock Structure No.0002 (i.e. the Riversdale Bridge) situated immediately north of Highway 9, between Kincardine and Walkerton, where shown on the attached map. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class Environmental Assessment Manual prepared by the Municipal Engineers Association (2015).

We are providing you with the attached *Notice of Project Initiation and Invitation to PIC No.1* for the Schedule 'B' EA, issued on October 22nd, 2020. The Schedule 'B' Project File (Version 1), which includes background technical reports, is available on the Municipality's website for viewing purposes. A Stage 1 and 2 Archaeological Assessment was completed for the study area in July 2017 and the cultural heritage evaluation was completed in August 2018.

Prior to proceeding with this project, we would like to know if you or your community have any questions or concerns regarding possible impacts to Aboriginal rights or title or if there are any other concerns with regard to the proposed project. Furthermore, should you require additional information, please contact the undersigned by telephone at (519) 881-2223 (ext.134) or by e-mail at gfurtney@brockton.ca. I would appreciate hearing back from you by November 23rd, 2020. If it is not possible to respond within this timeframe, please contact me to establish a mutually agreed upon timeframe. We will continue to provide updates as this project progresses.

I would like to thank you in advance for your consideration to this request and look forward to hearing back from you.

Yours truly,

Gregg Furtney, Director of Operations
Municipality of Brockton

Encl.

cc: Brent Willis, P.Eng., GM BluePlan Engineering



October 22, 2020

Saugeen First Nation
Chippewas of Saugeen First Nation No.29
6493 Highway 21
RR#1 Southampton, ON N0H 2L0

Attention: Chief Lester Anoquot and Cheree Urscheler

**RE: Riversdale Bridge (Greenock Structure No.0002)
Schedule 'B' Environmental Assessment
Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)**

I am writing to notify you that the Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Greenock Structure No.0002 (i.e. the Riversdale Bridge) situated immediately north of Highway 9, between Kincardine and Walkerton, where shown on the attached map. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class Environmental Assessment Manual prepared by the Municipal Engineers Association (2015).

We are providing you with the attached *Notice of Project Initiation and Invitation to PIC No.1* for the Schedule 'B' EA, issued on October 22nd, 2020. The Schedule 'B' Project File (Version 1), which includes background technical reports, is available on the Municipality's website for viewing purposes. A Stage 1 and 2 Archaeological Assessment was completed for the study area in July 2017 and the cultural heritage evaluation was completed in August 2018.

Prior to proceeding with this project, we would like to know if you or your community have any questions or concerns regarding possible impacts to Aboriginal rights or title or if there are any other concerns with regard to the proposed project. Furthermore, should you require additional information, please contact the undersigned by telephone at (519) 881-2223 (ext.134) or by e-mail at gfurtney@brockton.ca. I would appreciate hearing back from you by November 23rd, 2020. If it is not possible to respond within this timeframe, please contact me to establish a mutually agreed upon timeframe. We will continue to provide updates as this project progresses.

I would like to thank you in advance for your consideration to this request and look forward to hearing back from you.

Yours truly,

Gregg Furtney, Director of Operations
Municipality of Brockton

Encl.

cc: Brent Willis, P.Eng., GM BluePlan Engineering



October 22, 2020

Saugeen Ojibway Nation, Environmental Office
25 Maadookii Subdivision
Neyaashiinigmiing, ON N0H 2T0

Attention: Juanita Meekins

**RE: Riversdale Bridge (Greenock Structure No.0002)
Schedule 'B' Environmental Assessment
Notice of Project Initiation and Invitation to Virtual Public Information Centre (PIC No.1)**

I am writing to notify you that the Municipality of Brockton is advancing project specific planning to address the deteriorated condition of Greenock Structure No.0002 (i.e. the Riversdale Bridge) situated immediately north of Highway 9, between Kincardine and Walkerton, where shown on the attached map. The project is being planned under Schedule 'B' of the Municipal Class Environmental Assessment (EA), as outlined in the Municipal Class Environmental Assessment Manual prepared by the Municipal Engineers Association (2015).

We are providing you with the attached *Notice of Project Initiation and Invitation to PIC No.1* for the Schedule 'B' EA, issued on October 22nd, 2020. The Schedule 'B' Project File (Version 1), which includes background technical reports, is available on the Municipality's website for viewing purposes. A Stage 1 and 2 Archaeological Assessment was completed for the study area in July 2017 and the cultural heritage evaluation was completed in August 2018.

Prior to proceeding with this project, we would like to know if you or your community have any questions or concerns regarding possible impacts to Aboriginal rights or title or if there are any other concerns with regard to the proposed project. Furthermore, should you require additional information, please contact the undersigned by telephone at (519) 881-2223 (ext.134) or by e-mail at gfurtney@brockton.ca. I would appreciate hearing back from you by November 23rd, 2020. If it is not possible to respond within this timeframe, please contact me to establish a mutually agreed upon timeframe. We will continue to provide updates as this project progresses.

I would like to thank you in advance for your consideration to this request and look forward to hearing back from you.

Yours truly,

Gregg Furtney, Director of Operations
Municipality of Brockton

Encl.

cc: Brent Willis, P.Eng., GM BluePlan Engineering



October 22, 2020

Our File: 212326

Via Email: c.seider@waterprotection.ca

Drinking Water Source Protection
c/o Grey Sauble Conservation Authority
Risk Management Office
237897 Inglis Falls Road, RR#4
Owen Sound, ON N4K 5N6

Attention: Mr. Carl Seider

Re: Source Water Protection Consultation
Greenock Bridge No.0002
Riversdale, Municipality of Brockton

Dear Carl,

GM BluePlan Engineering has been retained by the Municipality of Brockton to undertake a Schedule 'B' Municipal Class Environmental Assessment (EA) planning process to address the deteriorated condition of Bridge No.0002 (i.e. Riversdale Bridge) located just north of Highway 9, centrally between Walkerton and Kincardine. A Project File for the bridge has been prepared to address the EA process (Municipal Engineers Association, 2015) and is available on the Municipality's website. The Project File discusses the findings, to date, of Phase 1 and, in part, Phase 2 of the Environmental Assessment.

As a simplified summary, the project proposes bridge removal and may result in road works within the existing rights-of-way, including:

- Complete bridge removal,
- General road works including regrading and minor alterations, and
- Landscaping of adjacent areas.

The creation of lands that would include chemical or fuel storage are not included as part of this plan.

Based on our preliminary review, the Study Area is not situated within a wellhead protection area (WHPA) or intake protection zone (IPZ). However, the Study Area is bordered by a Significant Groundwater Recharge Area (SGRA) with a vulnerability score of 4.

We have reviewed the recommended bridge removal and associated activities in relation to the *Tables for Drinking Water Threats*. Based on the potential scope of the project, it is not anticipated that:

- i. Any project activities will be considered a prescribed drinking water threat; or
- ii. Any activities will change or create new vulnerable areas.



As part of the EA process, we are reviewing the project with respect to requirements under the Clean Water Act. At this time, we are requesting confirmation of the above, as well as whether you are aware of any other potential considerations and policies in the Source Protection Plan that may apply to the project.

Should you have any questions, please feel free to contact our office.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in black ink, appearing to read 'M. Nelson'.

Matthew Nelson, P.Eng., P.Geo.
AN/kd

cc: Municipality of Brockton: Gregg Furtney, via Email – g.furtney@brockton.ca
File No. 212326

APPENDIX B:
PRE-CONSULTATION CORRESPONDENCE



1078 Bruce Road 12, P.O. Box 150, Formosa ON Canada N0G 1W0
Tel 519-367-3040, Fax 519-367-3041, publicinfo@svca.on.ca, www.svca.on.ca

SENT ELECTRONICALLY ONLY (swatson@brockton.ca)

April 18, 2018

Municipality of South Bruce
21 Gordon Street
Teeswater, Ontario
N0G 2S0

ATTENTION: Sonya Watson, CAO / Clerk

Dear Ms. Watson,

RE: Bridge No. 0002 (Riversdale Bridge) Draft Floodplain Analysis Report (GMBP File: 212326)
Draft Floodplain Analysis Report for Agency Review
Riversdale Bridge (0002)
Geographic Township of Greenock
Municipality of Brockton

This correspondence is in response to the receipt of the package with the cover letter dated February 1, 2018 received by Saugeen Valley Conservation Authority (SVCA) for Agency Review on February 2, 2018 for the above noted structure alternatives.

SVCA staff have reviewed the draft report dated February 2018. SVCA staff will make points after directly quoting in bold from the report for ease of reference.

Floodplain Backwater Analysis and Hydrology

1. **Page 2 of 6: Preliminary HEC-RAS cross-sections were developed using publicly available resources, including Bruce County Maps (1m elevation contours) and Ontario Base Map data.**

The Flood Model Cross-Section Location Plan shows 1 m intervals for the contours. In the opinion of the Engineer, are Bruce County's 1 m elevation contours from a 10 m DEM? If this is the case can they be considered accurate?

2. **Page 2 of 6: The MIDUSS model was developed using intensity-duration-frequency (IDF) data per the Mount Forest IDF station for the 10 to 100-year storm events.**

In the opinion of the Engineer, is the MIDUSS model and IDF appropriate for use in this situation and this location?

3. **Page 3 of 6: If Greenock Creek overtops its banks during a flood event, the flood waters would appear to drain westerly to the Teeswater River (downstream of the Sideroad 20 Bridge No. 0002 through the lower**



Watershed Member Municipalities

Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands, Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce, Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North, Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

lying lands and towards the downstream limit of the watershed area...

SVCA staff is in agreement with this assessment. In the opinion of the Engineer, how does that affect localized flooding that will affect Options 2 and 3 (specifically the road realignment of Sideroad 20)?

4. Table 2 - HEC-RAS Floodplain Model Water Surface Elevations (m)

Page 5 of 6: ...within the modelled area, are typically unchanged by either of the design alternatives.

Page 6 of 6: The relatively small geometry changes associated with the design alternatives, including an extension of Sideroad 20, have a negligible impact on the study area floodplain dynamics...

SVCA staff acknowledge that the extension of Sideroad 20 South may not dramatically affect the floodplain of the Teeswater River and Greenock Creek over the extent of the larger watershed area, but the ability of the local area to absorb the extra backwater flow has not been adequately addressed. Furthermore, it is not clear what parameters were used to model the conditions for the addition of fill for the Sideroad 20 extension and how this addition affects the floodplain area, wetland and flood elevations from displaced floodwaters.

Regardless, the extension of Sideroad 20 South through the wetland will affect the hydrology of the unevaluated wetland (swamp) and the Conservation of Land which is defined in the SVCA policy manual as “the protection, preservation, management or restoration of lands within the watershed ecosystem for the purposes of maintaining or enhancing the natural features and hydrologic and ecological functions with the watershed...”

SVCA staff would only agree to consider the alternate designs (those which include the Sideroad 20 South extension) with a detailed Environmental Impact Study (EIS) to include an overview of the natural features and functions of the wetland that may be impacted by the proposal, which could include, but may not be limited to:

- The groundwater recharge, discharge, quality and quantity, including flow paths and contributions
- Surface water quality and quantity, including flow paths and seasonal contributions from Greenock Creek
- Detailed description of the natural environment including a biophysical, hydrologic and hydrogeologic inventory and analysis
- Description of the Significant Habitat of endangered, threatened and species of concern
- Significant Wildlife habitat analysis

As mentioned in the 1986 and 2003 SVCA comments, the new road will alter the floodplain to some extent and the west side of the road bed will encroach into the Teeswater river bank. According to the SVCA Policy Manual, SVCA staff would require a complete application outlining how the proposal outlines the control of flooding, erosion, pollution and the conservation of land. Some of the further information that would need to be considered and included for SVCA review would include but may not be limited to:

- What volume of fill would be required for the new road construction, how does this volume of fill affect the floodwaters and what measures would be put in place to allow for the movement of waters east to west under the road

- Run the model (or indicate what parameters were used for the existing analysis) with the proposed road width including the road allowance width and proposed elevation
- Cross section with the road elevation, centerline profile and relief culvert locations or other structures that allow for unimpeded floodwater movement
- Soil surveys to indicate the depth of removal of unsuitable soils and disposal location
- Teeswater River bank reconstruction and protection measures
- An Environmental Impact Study prepared based on the specific plans
- Information on the removal of the existing Bridge if proposed and its potential replacement showing how the design doesn't alter the floodplain unacceptably, adequately addresses the same floodwater events and outlines the cut and fill equalization plan
- A SVCA Application to Alter a Watercourse, a SVCA Application to Alter a Regulated Area and related review fees

Other Agency Comments

In the past, Conservation Authorities served as the first point of contact and the local service provider for review of Section 35 of the previous version of the Fisheries Act and had entered into agreements with Fisheries and Oceans Canada to facilitate this process. Changes to the Fisheries Act effective November 25, 2013, have resulted in the cancellation of these agreements. It is now the responsibility of the proponent to contact the Department of Fisheries and Oceans at 1-855-852-8320 or <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html> to ensure their project addresses the Fisheries Act.

Conclusion

Although this report has suggested that surface water elevations are expected to be generally unchanged or negligibly increased from existing conditions, SVCA staff are of the opinion that the assessment tools may not have been strident enough to address the backwater flooding from Greenock Creek and the potential impacts from such, especially when smaller flood events much smaller than the Regulatory Event cause conditions where floodwaters have been observed by SVCA staff to be level with sideroad 20 just east of the existing Bridge No. 0002.

SVCA staff recommend that the alternatives that contain extending Sideroad 20 North are not included for consideration, but you may provide an Application for SVCA review at any time.

Sincerely,



Michelle Gallant
Regulations Officer
Saugeen Conservation



Watershed Member Municipalities

Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands, Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce, Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North, Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

MG/

cc: John Strader, Municipality of Brockton (via e-mail)
John Slocombe, P. Eng., G.M. Blue Plan Engineering (via e-mail)
Brent Willis, P. Eng., G.M. Blue Plan Engineering (via e-mail)
Dan Gieruszak, Authority Member, SVCA (via e-mail)

Watershed Member Municipalities

Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands,
Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce,
Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North,
Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

Drea Nelson - GM BluePlan

From: Gary Senior <G.Senior@SVCA.ON.CA>
Sent: Monday, July 17, 2017 10:00 AM
To: John Slocombe - GM BluePlan; Drea Nelson - GM BluePlan; Michelle Gallant
Subject: Re: 212326 Bridge No 0002, Greenock: Hydrological Considerations

Hello John,

In response to your email of July 10, 2017 and Drea Nelson's email of June 30, 2017, SVCA staff offers the following comments.

At the outset, these comments are in regard to hydrological information only, as other staff will be conducting the review of this project and handling matters relating to SVCA Regulation 169/06, as amended.

I am not aware of any engineered floodline mapping for this area.

There have been a couple of occasions over the last thirty years or so when this project was proposed. Gamsby and Mannerow Ltd. was the consultant on both occasions, so I assume you have access to those files. The SVCA's last correspondence was on August 18, 2003. If you do not have that letter on file, we can email it to you. That letter includes some items that are now out-of-date, but one item recommends a flood plain (backwater) analysis be undertaken. That recommendation remains in effect.

The SVCA has a stream gauge station on the Teeswater River at Bruce Road 20, downstream of the subject site. The historical flow data can be made available to you upon request. Water Survey of Canada has a stream gauge in the community of Teeswater, upstream of the site.

Perhaps a complicating factor from a hydrological perspective is the nearby Greenock Creek, which crosses under Highway 9 just east of Riversdale. Under normal flow conditions Greenock Creek flows south under Highway 9 and joins the Teeswater River just upstream of Riversdale. Under flood conditions, the Teeswater River overtops its banks and can send some of its flow up the Greenock Creek channel, in effect causing a reverse flow condition for that creek. Typical flooding does cover a broad area, and hydrologic modelling for the Teeswater River alone may be insufficient, as Greenock Creek does contribute as well.

MTO replaced the bridge over Greenock Creek in 1986. The SVCA does not have an MTO hydrological report for that project, given the opening size didn't change and no historical hydrological problems were identified. However, you could check with MTO in case such a report was done. Although the value of a report from 1986 would be limited.

Regards,

Gary Senior,
Sr. Manager Flood Warning and Land Management
Saugeen Conservation
1078 Bruce Road 12, P.O. Box 150
Formosa, ON N0G 1W0
 [\(519\) 367-3040 ext. 234](tel:5193673040)

[\(519\) 367-3041](tel:5193673041) fax
g.senior@svca.on.ca

From: John Slocombe - GM BluePlan <John.Slocombe@gmbblueplan.ca>
Sent: July 10, 2017 3:07:14 PM
To: Gary Senior
Cc: Erik Downing
Subject: 212326 Bridge No 0002, Greenock: Hydrological Considerations

Hi Gary,

Just following up on the following e-mail.

I was hoping to get a sense from the SVCA perspective of the alternative to eliminate the "Bridge Street" bridge and run Sideroad 2 straight to Highway 9.

Although I suspect there is a reason that the bridge was built instead of the road "back in the day", from a flood plain perspective, at first glance, it seems there may be potential for improvement if the existing approach fills were to be removed across the river.

Do you have existing flood line mapping / modeling?

Any thoughts on whether or not updated modeling would be necessary?

Appreciate any input.

Thanks.

John Slocombe, P.Eng.
Branch Manager, Vice President

GM BluePlan Engineering Limited
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 | c: 519.372.4600
john.slocombe@gmbblueplan.ca | www.gmbblueplan.ca



From: Drea Nelson - GM BluePlan
Sent: Friday, June 30, 2017 12:06 PM
To: g.senior@svca.on.ca; jstrader@brockton.ca
Cc: John Slocombe - GM BluePlan; Brent Willis - GM BluePlan
Subject: 212326 Bridge No 0002, Greenock: Hydrological Considerations

Gary and John,

We have been retained by the Municipality of Brockton to complete an Environmental Assessment process for an aging bridge in the Village of Riversdale. More specifically Bridge No. 0002 which is located within Lot 30, Concession 1N in the former Township of Greenock. The subject bridge is part of Bridge Street and crosses the Teeswater River, where shown in the attached Figures. The structure is a steel through truss bridge and is supported by concrete abutments and wingwalls with an overall span of 37.1 meters. Several photos are attached for your reference.

At this time it is anticipated that the existing bridge will be removed. Following bridge removal, bridge replacement or road re-alignment will be considered (i.e. the extension of Sideroad 20 directly south to Highway 9). A review of the SVCA 169/06 Mapping (Sheet No. 584) indicates that the study area, including the area being considered for the road re-alignment, is situated within an SVCA screening area. Based on a review of available mapping (i.e. topographic contours, significant wetlands and zoning), it appears that the extensive screening area likely pertains to a floodplain. In consideration of the potential road re-alignment, we are requesting whether you are aware of any additional

floodplain/flood-hazard mapping and/or information for this area (i.e. Riversdale), more specifically the area to the east of the river and in the vicinity of the Right-of-Way and the Bridge (refer to attached Figures)?

Let me know if you have any questions,

Regards,
Andrea

Andrea Nelson, M.Sc.

Senior Hydrogeologist

GM BluePlan Engineering Limited

1260-2nd Avenue East | Owen Sound ON N4K 2J3

t: 519.376.1805 | c: 519.372.4678

andrea.nelson@gmblueplan.ca | www.gmblueplan.ca



N O T I C E - This message from GM BluePlan Engineering Limited is intended only for the use of the individual or entity to which it is addressed and may contain information which is privileged, confidential or proprietary. Internet communications cannot be guaranteed to be secure or error-free as information could be intercepted, corrupted, lost, arrive late or contain viruses. By communicating with us via e-mail, you accept such risks. When addressed to our clients, any information, drawings, opinions or advice (collectively, "information") contained in this e-mail is subject to the terms and conditions expressed in the governing agreements. Where no such agreement exists, the recipient shall neither rely upon nor disclose to others, such information without our written consent. Unless otherwise agreed, we do not assume any liability with respect to the accuracy or completeness of the information set out in this e-mail. If you have received this message in error, please notify us immediately by return e-mail and delete the message from your computer systems.



261123 Concession 18
Twp. of West Grey
(former Normanby Twp.)

Mailing Address:
R.R. 1, Hanover, ON
N4N 3B8 Canada

Tel 519-364-1255
Fax 519-364-6990
www.svca.on.ca
publicinfo@svca.on.ca

FILE COPY

* See GI
11/07/1986 ✓

Lot 30 + 31

August 18, 2003

Con INDR

Gree

SCANNED

FEB 02 2017

Saugeen Conservation

GI
08/18/03
Gree
FAXED
18/03

East of
Riversdale

Gamsby and Mannerow Limited
652 Third Avenue East
Owen Sound, ON
N4K 2K1

ATTENTION: J. V. Dowdall, C.E.T.

Dear Mr. Dowdall:

RE: Sideroad 20 Extension
Former Township of Greenock
Municipality of Brockton

In response to your correspondence of July 21, 2003, the Saugeen Valley Conservation Authority offers the following comments. Given that the original comments for this proposed road project were provided by the SVCA almost 17 years ago, the following comments replace that previous letter.

1. The Teeswater River is subject to the federal *Fisheries Act*, as fish habitat is present. Also, there may be small field ditches or intermittent channels within the project area that might exhibit fish habitat. Section 35 of the *Fisheries Act* prohibits the harmful alteration, disruption, or destruction of fish habitat unless authorization is given by the Minister of Fisheries and Oceans, subject to appropriate terms and conditions.

As you are aware, the SVCA has a Level 2 Fish Habitat Management Agreement with Fisheries and Oceans Canada, Ontario - Great Lakes Area, through which the SVCA reviews projects for potential impacts on fish habitat on behalf of DFO. In the SVCA's opinion this project may affect fish habitat; therefore, we advise you to contact DFO to obtain their comments.

From the Authority's preliminary review of this proposal, there are at least five aspects of this project that may be of concern from a fish habitat standpoint. One, the west side of the road bed in the vicinity of the existing bridge will be encroaching into the river. Two, most of the new road will be located in an area that is seasonally flooded and such flooded areas are typically used by

Conservation
Through
Cooperation



A MEMBER OF THE
CONSERVATION
ONTARIO NETWORK

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M
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Northern Pike for spawning. Three, the ditches or intermittent channels might be altered. Four, loss of riparian vegetation. Five, removal of the existing bridge could cause an effect on habitat if not done appropriately. One or more of these impacts may cause a loss of habitat, which means DFO authorization will be necessary.

For this project you should obtain any further comments on the *Fisheries Act* directly from DFO, and not the SVCA, unless they indicate otherwise.

2. As mentioned in the Authority's comments in 1986, the new road will alter the flood plain to some extent. We are aware that the road elevation will generally be no higher than 901.0 feet, that two relief culverts are included, and in 1986 you indicated no buildings would be affected. Nevertheless, the SVCA will require that you quantify the effect on the flood plain by means of a backwater analysis.

The analysis should use an appropriate computer model (e.g. HEC-2) to calculate river flood levels for the existing and proposed state for the 10, 25, 50, and 100 year events and the Regional Storm flood.

3. As this project will involve the construction of an entirely new road, perhaps the Class Environmental Assessment for Municipal Road Projects is applicable? The SVCA does not administer the EA legislation but we would like your comments on this item.
4. This general area typically experiences flooding at least on an annual basis and flood water can stay elevated for a number of days. Construction activity should be timed to avoid the likelihood of flooding. However, while the flooding here is usually a spring time occurrence, it can happen at any time. Accordingly, construction operations should be organized to minimize its exposure to flooding. For example, equipment and materials should be stored above the flood elevation.
5. The Authority will require information on the intended removal and site restoration procedures for the existing bridge, if removal is proposed.
6. A permit under the SVCA's Alteration to Waterways regulations (Revised Regulations of Ontario 169/90) will be required. Before submitting an application to this office, the Authority suggests that you address the design issues raised in this letter, and any issues arising from other agencies, before formally applying for a permit.

Gamsby and Mannerow Limited
August 18, 2003
Page 3

Should questions arise, do not hesitate to contact this office.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Gary Senior". The signature is fluid and cursive, with the first name "Gary" and last name "Senior" clearly distinguishable.

Gary Senior, Manager
Environmental Planning and Regulations

GS/

cc: Derrick Moggy, Fish Habitat Biologist, DFO, Harvester Road, Burlington
Roland Anstett, Director, SVCA

Drea Nelson - GM BluePlan

From: Katzirz, Zsolt (MTO) <Zsolt.Katzirz@ontario.ca>
Sent: Wednesday, March 28, 2018 9:59 AM
To: Heather Goodman
Cc: Drea Nelson - GM BluePlan; Rajan Philips; John Slocombe - GM BluePlan
Subject: MTO Comments - Hwy 9 - Riversdale Bridge - TIS & TOR
Attachments: 212326 Riversdale Bridge (Zoning).pdf; 180043 (Riversdale Bridge EA) - Study Area.pdf

Hi Heather,

Per discussion we have several concerns with the proposed "new intersection" including the following (and not limited to):

- Proximity of intersection to structure on Highway 9.
- Intersection spacing. MTO minimum intersection spacing for a new intersection (or commercial entrance) is 1600m desire (800m minimum).

For the above noted reasons we are not supportive of the proposed new intersection. Please note that we need to understand (and accept) the concept in general prior to requiring supporting reports, there are significant limitations to reports such as a traffic impact study.

Please feel free to contact me for further discussion.

Regards,

Zsolt Katzirz | Highway Corridor Management Planner
Highway Corridor Management | West Region | Engineering Office
Provincial Highways Management | Ministry of Transportation
1st Floor | 659 Exeter Road | London, ON, N6E 1L3
Telephone: 519-873-4598 | Toll Free: 1-800-265-6072 Ext. 4598
Fax: (519) 873-4228 | E-mail: zsolt.katzirz@ontario.ca

Please consider the environment before printing this email



Public Website: <http://www.mto.gov.on.ca/english/engineering/management/corridor/index.shtml>

From: Heather Goodman [mailto:hgoodman@ptsl.com]
Sent: March-27-18 3:48 PM
To: Katzirz, Zsolt (MTO)
Cc: Drea Nelson - GM BluePlan; Rajan Philips; John Slocombe - GM BluePlan
Subject: RE: 180043 (Riversdale Bridge) - Terms of Reference

Hi Zsolt,

I want to clarify that this is not a typical TIS where a development is being contemplated. The purpose of this analysis is to determine if the extension of Side Road 20 to a new intersection connection on Highway 9 is feasible from a transportation perspective, including sight lines, intersection spacing, traffic control, auxiliary lanes, etc. We want to ensure the study conforms to MTO's requirements, specifically the growth rate for the area. That way, if this alternative is selected for further analysis, the traffic study conforms to MTO requirements.

I can provide the following information regarding the intersection based on the site visit and analysis completed thus far. Attached is a figure of the study area:

- The proposed intersection would be located east of the Teeswater River, on the north side of Highway 9 as a direct southward extension of Side Road 20. There is an existing road allowance for this extension. The road allowance may have to be moved to the east to avoid the floodplains. (See attached parcel map).
- The proposed Side Road 20 extension would be a two-lane roadway.
- The proposed intersection would be a T-intersection, with stop-control on Side Road 20 and free flow on Highway 9. No auxiliary lanes would be required.
- This is approximately 235 metres east of Union Street and 780 metres west Moscow Side Road. There is a private driveway approximately 240 metres east of the proposed intersection. The location of the proposed intersection meets TAC minimum spacing requirements
- Sight distance of over 350 metres is provided in each direction. This exceeds TAC recommendations.
- The speed limit on Highway 9 at this location is 80 km/h east of the Teeswater River bridge and 70 km/h to the west.

Please let me know if you have any questions.

Thanks,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant



Paradigm Transportation Solutions Limited

p: 416.479.9684 x502
m: 905.506.0454

From: Katzirz, Zsolt (MTO) [<mailto:Zsolt.Katzirz@ontario.ca>]
Sent: March 21, 2018 9:32 AM
To: Heather Goodman <hgoodman@ptsl.com>
Subject: RE: 180043 (Riversdale Bridge) - Terms of Reference

Hi Heather,

Prior to agreeing to a traffic impact study we need to see conceptual plans of what is being proposed.

If an intersection is being re-aligned (along the provincial highway) we need to review items such as (but not limit to) intersection spacing and site lines to determine if we agree in principle prior to asking for supporting data such as a traffic impact study.

Regards,

Zsolt Katzirz | Highway Corridor Management Planner
Highway Corridor Management | West Region | Engineering Office
Provincial Highways Management | Ministry of Transportation
1st Floor | 659 Exeter Road | London, ON, N6E 1L3
Telephone: 519-873-4598 | Toll Free: 1-800-265-6072 Ext. 4598
Fax: (519) 873-4228 | E-mail: zsolt.katzirz@ontario.ca

Please consider the environment before printing this email



From: Heather Goodman [<mailto:hgoodman@ptsl.com>]

Sent: March-13-18 11:42 AM

To: Katzirz, Zsolt (MTO)

Cc: Rajan Philips; Drea Nelson - GM BluePlan; John Slocombe - GM BluePlan; Brent Willis - GM BluePlan;
jstrader@brockton.ca

Subject: 180043 (Riversdale Bridge) - Terms of Reference

Hi Zsolt,

Further to our phone discussion last week, Paradigm has been retained by the Municipality of Brockton to carry out a Transportation Impact Study to provide background information prior to the Municipal Class Environmental Assessment (EA) that the Municipality is undertaking to address an aging heritage bridge in Riversdale, located on Side Road 20, to the north of Highway 9, detailed in the enclosed project overview and work plan. The TIS is being undertaken prior to initiating the EA process to determine the technical feasibility of some of the potential alternatives that may be considered in the EA.

We ask that you please review the work plan to ensure the scope of the study is acceptable and provide comments if necessary.

In addition, we request the following information from MTO for our study:

- ▶ The following intersections will be included in the study, please confirm this is acceptable.
 - Highway 9 at Union Street (two-way Stop-controlled);
 - Highway 9 at High Street (two-way Stop-controlled);
 - Union Street at Melvin Street (two-way Stop-controlled); and
 - Side Road 20 on the subject bridge.
- ▶ The traffic impact study will be prepared to conform to MTO guidelines and will assess a 20-year horizon. Please confirm this is acceptable.
- ▶ Please provide the growth rate to be used for the study.

Due to the time sensitive nature of the project, we ask that you please provide comments at your earliest convenience. Please do not hesitate to contact me if you have questions relating to this project.

Regards,

Heather Goodman, B.Eng., EIT, MITE

Transportation Consultant



Paradigm Transportation Solutions Limited

5000 Yonge Street, Suite 1901, Toronto ON M2N 7E9

p: 416.479.9684 x502

m: 905.506.0454

e: hgoodman@ptsl.com

w: www.ptsl.com

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APPENDIX C: TECHNICAL ENVIRONMENT – SUPPORTING INFORMATION

BRIDGE INSPECTION REPORT

Structure No.: 0002
MTO Site No.: 2-262
Location: Lot 30, Concession 1 N, Greenock Survey
Date of Inspection: May 25, 2016
Inspector: Frank R. Palmay, P.Eng.
Estimated Safe Loading: Triple Posting: 8, 13 and 21 tonnes

Structure Description:

| | | | |
|-------------------------|---------------------------------|--------------------------|-------------|
| Structure: | Steel through truss | Year Constructed: | 1920 (est.) |
| No. Spans: | 1 | Width: | 4.2m |
| Approaches: | Gravel to east, asphalt to west | | |
| Wearing Surface: | Laminated 2x6 timber deck | | |

Remarks:

- Laminated timber deck is in good condition.
- The pipe handrails across the deck are bent. The south pipe handrail is very severely corroded such that approximately half of the cross-sectional area is missing. It appears that short lengths of pipe have been added to splice the original handrail together at locations of severe corrosion.
- The northeast and southeast approach guiderails have been impacted. A wood post is missing from the northeast approach guiderail. At the impact area on the southeast approach the guiderail is no longer attached to a wooden post.
- A bearing block is missing on a wood post in the southeast approach guiderail.
- West wingwalls have medium to severe spalling and scaling throughout.
- The east wingwalls have medium to severe spalling, numerous some random cracking and concrete is delaminating. There is efflorescence in the cracks indicating water is leaking through the wall.
- Northwest wingwall has severe vertical crack that appears to be through the thickness of the wall. The long term stability of this wall is questionable, however, it may be large enough to act as a gravity retaining wall.
- The northeast wingwall has numerous areas of severe spalling.
- Both concrete abutments and bearing seats have severe scaling and spalling to reveal reinforcing steel.
- Truss seats are dirty.
- No curbs at edge of deck.
- The floor beams are heavily corroded at the flanges reducing the area of the beam. Given the scope of investigation the deterioration of the interior cross beams was difficult to evaluate.
 - The west most single angle floor beam has very severe corrosion.
 - The third from the west has corroded to the point that the top flange is no longer connected to the web near midspan.
 - The second from the west floor beam has been replaced.
- The west most vertical web member on the south truss is permanently deformed.
- The east most vertical web member on the north truss is permanently deformed.
- The 2nd diagonal from the east on the north truss is permanently deformed, due to impact damage.
- One diagonal web member in the southwest corner and one cross beam have been replaced. These members will require periodic painting to inhibit corrosion.

- The eastern most bottom gusset plate connection the truss web to the bottom chord on the south truss is severely bent.
- Anchor bolts on west abutment are bent possibly due to thermal movements of structure.

Conclusions:

The structure appears to be in overall fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed (noted since the 2007 report), and appears to be in overall fair to poor condition. The vertical member which is worsening is a tension member and is of less concern than the deformed bottom gusset. The concrete substructure appears to be in overall poor condition with severe to very severe cracking, spalling and delamination. The overall stability of the concrete abutments and wingwalls is questionable. The severe vertical crack through the northwest wingwall was identified in the 2005 report. Although the crack does not appear to be getting larger, failure of this wingwall will cause the single lane approach to slump which will require closure of the road to repair.

Recommendations:

1. Complete a load posting evaluation immediately to determine if current posting is accurate.
2. Close structure or replace structure within 2 years.

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in blue ink, appearing to read 'Frank R. Palmay'.

Frank R. Palmay, P.Eng.



BRIDGE/CULVERT INSPECTION REPORT– 2016
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY

Structure No. 0002



Photo 1 - View of structure from east.



Photo 2 - View of structure from northeast.

**BRIDGE/CULVERT INSPECTION REPORT– 2016
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 3 - View of soffit.



Photo 4 - View of spalled and delaminated concrete on wingwall and abutment.

**BRIDGE/CULVERT INSPECTION REPORT– 2016
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 5 - View of typical moderate to severe corrosion of floor beams.



Photo 6 - View of damage to guardrail at west approach.

**BRIDGE/CULVERT INSPECTION REPORT– 2016
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 7 - View of wide crack at southwest abutment/wingwall interface.



Photo 8- View of typical severe spalling of concrete.

**BRIDGE/CULVERT INSPECTION REPORT– 2016
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 9- View of buckled western most vertical member on the south truss.



Photo P-10- View of deformed truss plate on south truss, east end.

BRIDGE REVIEW REPORT

Structure No.: 0002
MTO Site No.: 2-262
Structure Name: Riversdale Bridge
Location: Lot 30, Concession 1 N, Greenock Survey
Date of Review: May 29, 2018
Inspector: Jesse Borges, EIT
Estimated Safe Loading: Triple Posting: 8, 13 and 21 tonnes

Structure Description:

Structure: Steel through truss **Year Constructed:** 1920 (est.)
No. Spans: 1 **Width:** 4.2m **Length:** 37.1m
Approaches: Gravel to east, asphalt to west
Wearing Surface: Laminated 2x6 timber deck

Remarks:

- Laminated timber deck is in good condition.
- The pipe handrails along the deck are bent due to impact damage. Most of the handrail is experiencing medium to severe corrosion. It appears that short lengths of pipe have been added to splice the original handrail together at locations of severe corrosion.
- The northeast and southeast approach guiderails have been impacted. A bearing block is missing on a wood post in the southeast approach guiderail.
- The top chord has impacted damage at southeast and northwest.
- Truss system has extensive minor to medium surface corrosion throughout the structure.
- West wingwalls have medium to severe spalling and scaling throughout.
- The east wingwalls have medium to severe spalling, delaminations and numerous random cracks. There is efflorescence in the cracks indicating water is leaking through the wall.
- The northwest wingwall has a large vertical crack that has extended through the full thickness of the wall. Day light could be seen through the crack from the roadway. The long term stability of this wall is questionable, however, it may be large enough to act as a gravity retaining wall.
- The northeast wingwall has numerous areas of severe spalling.
- Both concrete abutments and bearing seats have severe scaling and spalling to reveal reinforcing steel.
- Truss bearing seats are covered in debris and vegetation.
- Steel bearing pads under stringers have severe corrosion.
- No curbs at edge of deck.
- The floor beams are heavily corroded at the flanges reducing the area of the beam. Given the scope of investigation the deterioration of the interior cross beams was difficult to evaluate.
 - The west most floor beam has severe corrosion with perforations near the top flange.
 - The third from the west has severe corrosion and a large perforation that has disconnected the top flange from the web in localized area.
 - The second from the west floor beam has been replaced.
 - The east most floor beam has severe corrosion with deep pitting.
- The west most vertical web member on the south truss is permanently deformed.
- The east most vertical web member on the north truss is permanently deformed.
- The 2nd diagonal from the east on the north truss is permanently deformed, due to impact damage.

- One diagonal web member in the southwest corner and one cross beam have been replaced. These members will require periodic painting to inhibit corrosion.
- The eastern most bottom gusset plate connection the truss web to the bottom chord on the south truss is severely bent.
- Anchor bolts on west abutment are bent possibly due to thermal movements of structure.

Conclusions:

The structure appears to be in overall fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed (noted since the 2007 report), and appears to be in overall fair to poor condition. The vertical member which is worsening is a tension member and is of less concern than the deformed bottom gusset. The concrete substructure appears to be in overall poor condition with severe to very severe cracking, spalling and delamination. The overall stability of the concrete abutments and wingwalls is questionable. The severe vertical crack through the northwest wingwall was identified in the 2005 report. Although the crack does not appear to be getting larger, failure of this wingwall will cause the single lane approach to slump which will require closure of the road until repaired.

Considering the overall condition of the structure, we are recommending that the following bridge be closed or replaced within 2 years. It is our opinion that performing any major repairs to the following structure would only delay the structures closure/replacement and would not be financially beneficial to the Township. A detailed investigation and load evaluation was completed in 2017 which confirmed the current load posting. We recommend that the load posting be re-evaluated in 2019.

The Municipality of Brockton is currently completing a Municipal Class Environmental Assessment (Schedule 'B') on the structure to determine the impacts to the surrounding environment and public if the following solutions are implemented:

- a) Do Nothing,
- b) Repair Existing Structure,
- c) Replace existing Structure,
- d) Remove Existing Structure.

Recommendations:

1. Complete a load posting evaluation immediately to determine if current posting is accurate.
2. Close structure or replace structure within 2 years.

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in black ink, appearing to read 'Jesse Borges'.

Jesse Borges, E.I.T.

**BRIDGE/CULVERT REVIEW REPORT– 2018
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 1 - View of structure from east.



Photo 2 - View of structure from northeast.

**BRIDGE/CULVERT REVIEW REPORT– 2018
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 3 - View of damaged guiderail at southeast.



Photo 4 - View of northeast railing with severe corrosion.

**BRIDGE/CULVERT REVIEW REPORT– 2018
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 5 - View of damaged top chord at northwest.



Photo 6 - View of damaged vertical member at southwest.

**BRIDGE/CULVERT REVIEW REPORT– 2018
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 7 - View of severe scaling and spalling at west abutment.



Photo 8- View of wide vertical crack at northwest wingwall.

**BRIDGE/CULVERT REVIEW REPORT– 2018
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 9- View of severe scaling and spalling on top of abutment wall.



Photo P-10- View of soffit.

**BRIDGE/CULVERT REVIEW REPORT– 2018
MUNICIPALITY OF BROCKTON
GREENOCK SURVEY**

Structure No. 0002



Photo 11- View of severe corrosion in western most floor beam.



Photo 12 - View of severely corroded bearing bad.



Riversdale Bridge

Structure: 0002

Retaining Wall Condition Index : 33

Additional Investigations

| | <u>Priority</u> | | | <u>Estimated Cost</u> |
|---|-------------------------------------|--------------------------|--------------------------|-----------------------|
| | None | Normal | Urgent | |
| Detailed Deck Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Non-Destructive Delamination Survey of Asphalt Covered Deck | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Substructure Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Detailed Coating Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Detailed Timber Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Post-Tension Strand Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Underwater Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Fatigue Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Seismic Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Structure Evaluation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Monitoring of Deformations, Settlements & Movements | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Monitoring of Crack Widths | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Total Additional Investigations Cost | | | | \$0 |

Recommended Work

| <u>Element</u> | <u>Repair / Rehab</u> | <u>Status</u> | <u>Cost</u> |
|---|---|---------------|--------------------|
| Abutments - Abutment Walls | Replace entire bridge substructure. | <1 Year | \$75,000 |
| Approaches - Barriers | Replace guiderail system and install code compliant end treatments. | <1 Year | \$39,000 |
| Approaches - Wearing Surface | Pave approaches and bridge deck top during bridge replacement. | <1 Year | \$10,000 |
| Decks - Deck Top | Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal. | <1 Year | \$720,000 |
| Embankments & Streams - Embankments | Embankments to be excavated and reconstructed during bridge replacement. | <1 Year | \$80,000 |
| Foundations - Foundation (below ground level) | Replace bridge foundations. | <1 Year | \$79,000 |
| Sub-Total Recommended Work Cost | | | \$1,003,000 |
| Sub-Total Associated Work Cost | | | \$140,000 |
| Contingencies 10.00% | | | \$114,000 |
| Engineering 10.00% | | | \$114,000 |
| Total Recommended & Associated Work Cost | | | \$1,371,000 |

Maintenance Needs

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Summary Action Report

Inspection Date: 4/24/2020

Bridge Condition Value (BCI) 33

Next Biennial Inspection: 4/24/2022

Performance Deficiencies

| Element Group | Element Name | Performance Deficiency |
|---------------|----------------|-----------------------------|
| Abutments | Abutment Walls | Load carrying capacity |
| Abutments | Wingwalls | Load carrying capacity |
| Approaches | Barriers | Pedestrian/vehicular hazard |
| Barriers | Hand Railings | Load carrying capacity |
| Beams | Floor Beams | Load carrying capacity |

Maintenance Needs

Repair/Rehabilitation

| Element Group | Element Name | Repair/Rehabilitation | Priority | Est. Cost |
|----------------------------------|---------------------------------|---|----------|-------------|
| Abutments | Abutment Walls | Replace entire bridge substructure. | <1 Year | \$75,000 |
| Approaches | Barriers | Replace guiderail system and install code compliant end treatments. | <1 Year | \$39,000 |
| Approaches | Wearing Surface | Pave approaches and bridge deck top during bridge replacement. | <1 Year | \$10,000 |
| Decks | Deck Top | Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal. | <1 Year | \$720,000 |
| Embankments & Streets | Embankments | Embankments to be excavated and reconstructed during bridge replacement. | <1 Year | \$80,000 |
| Foundations | Foundation (below ground level) | Replace bridge foundations. | <1 Year | \$79,000 |
| Total Repair/Rehabilitation Cost | | | | \$1,003,000 |
| Total Associated Work Cost | | | | \$368,000 |
| Total Cost | | | | \$1,371,000 |

Overall Comments

The structure appears to be in fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed. The floor beams below the deck are exhibiting severe corrosion and section loss which has reduced the load carrying capacity of the bridge. The concrete substructure appears to be in overall fair to poor condition with severe to very severe cracking, spalling and delaminations. The overall stability of the concrete abutments and wingwalls (especially west side) is questionable. We recommend that the structure be removed or replaced within 1 year. Until construction can be scheduled, we recommend that the bridge be closed to all vehicle traffic due to a load carrying capacity concern.

Additional Investigations

\$0.00

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Inventory Data:

| | | | |
|----------------------------|------------------------------|--|---|
| Structure Name | Riversdale Bridge | | |
| Main Hwy/Road # | Side Road 20 | On <input checked="" type="checkbox"/> Under <input type="checkbox"/> | Crossing Type: Nav Water <input type="checkbox"/> Non Nav Water <input checked="" type="checkbox"/> |
| Hwy/Road Name | | Rail <input type="checkbox"/> Road <input checked="" type="checkbox"/> Ped <input type="checkbox"/> Other <input type="checkbox"/> | |
| Structure Location | 0.7km north of County Road 9 | | |
| Latitude (decimal degrees) | 44.0936 | Longitude (decimal degrees) | -81.33669 |
| Owner(s) | Municipality of Brockton | Heritage: | Not Cons <input type="checkbox"/> Cons Not/App <input checked="" type="checkbox"/> List/Not Desig <input type="checkbox"/> |
| Region | Southwestern | Designation: | Design Not List <input type="checkbox"/> Design List <input type="checkbox"/> |
| District | Owen Sound | Road Class: | Freeway <input type="checkbox"/> Arterial <input type="checkbox"/> Collector <input type="checkbox"/> Local <input checked="" type="checkbox"/> |
| Old County | | No. of Lanes | 1 Posted Speed 80 (km/h) |
| Geographic Twp | Brockton | AADT | Trucks (%) |
| Structure Type | Retaining Wall | | |
| Total Deck Length | 37.7 (m) | | |
| Overall Str Width | 5 (m) | | |
| Total Deck Area | 188.5 (sq m) | Min. Vertical Clearance | (m) |
| Roadway Width | 4.1 | Special Routes: | Transit <input type="checkbox"/> Truck <input type="checkbox"/> School <input type="checkbox"/> Bicycle <input type="checkbox"/> |
| Skew Angle | 0 (deg) | Detour Length | (km) |
| No. of Spans | 1 | Direction of Structure | East/West |
| Span Lengths | 37.1 (m) | Fill on Structure | (m) |

Historical Data:

| | | | |
|---|-------------|----------------------------|------------------|
| Year Built | 1920 (est.) | Year of Last Rehab | 2003 |
| Last OSIM Inspection | 5/29/2018 | Last Evaluation | 2017 |
| Last Enhanced OSIM Inspection | | Current Load Limit | 8/13/21 (tonnes) |
| Enhanced Access Equipment (ladder, boat, lift, etc) | | Load Limit By Law | |
| | | By Law expiry Date | |
| Last Condition Survey | | Last underwater Inspection | |

Rehabilitation History:

| Date | Type | Description |
|-----------|-------|---|
| 11/1/2003 | Rehab | Replacement of steel stringers (partial) and timber deck top. |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Field Inspection Information:

Date of Inspection: 04/24/2020
(mm/dd/yyyy)

Inspection Type: OSIM

Inspector: Jesse Borges, P.Eng.

Others in Party: Trevor O'Brien, P.Eng.

Equipment Used: Hammer, camera, ladder, measuring tape

Weather: Sunny

Temperature °C: 8

Additional Investigations Required:

| | Priority | | | Estimated Cost |
|---|-------------------------------------|--------------------------|--------------------------|----------------|
| | None | Normal | Urgent | |
| Detailed Deck Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Non-destructive Delam. Survey of Asphalt-Covered Deck | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Concrete Substructure Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Detailed Coating Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Detailed Timber Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Post-Tensioned Strand Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Underwater Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Fatigue Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Seismic Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Structure Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Monitoring Deformations, Settlements, Movements | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Monitoring Crack Widths | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Total Cost: | | | | \$0 |

Investigation Notes:

Overall Structure Notes:

Overall Comments: The structure appears to be in fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed. The floor beams below the deck are exhibiting severe corrosion and section loss which has reduced the load carrying capacity of the bridge. The concrete substructure appears to be in overall fair to poor condition with severe to very severe cracking, spalling and delaminations. The overall stability of the concrete abutments and wingwalls (especially west side) is questionable. We recommend that the structure be removed or replaced within 1 year. Until construction can be scheduled, we recommend that the bridge be closed to all vehicle traffic due to a load carrying capacity concern.

Recommended Work: Replace

Next Inspection: 04/24/2022

Recommended Work Time: <1yr

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Suspected Performance Deficiencies

- 00 None
- 01 Load carrying capacity
- 02 Excessive deformations (deflections & rotations)
- 03 Continuing settlement
- 04 Continuing movements
- 05 Seized bearings

- 06 Bearing not uniformly loaded/unstable
- 07 Jammed expansion joint
- 08 Pedestrian/vehicular hazard
- 09 Rough riding surface
- 10 Surface ponding
- 11 Deck drainage

- 12 Slippery surface
- 13 Flooding/channel blockage
- 14 Undermining of foundation
- 15 Unstable embankments
- 16 Other

Maintenance Needs

- 01 Lift & Swing Bridge Maintenance
- 02 Bridge Cleaning
- 03 Bridge Handrail Maintenance
- 04 Painting Steel Bridge Structures
- 05 Bridge Deck Joint Repair
- 06 Bridge Bearing Maintenance

- 07 Repair to Structural Steel
- 08 Repair to Bridge Concrete
- 09 Repair to Bridge Timber
- 10 Bailey Bridges - Maintenance
- 11 Animal/Pest Control
- 12 Bridge Surface Repair

- 13 Erosion Control at Bridges
- 14 Concrete Sealing
- 15 Rout and Seal
- 16 Bridge Deck Drainage
- 17 Scaling (Loose Concrete or ACR Steel)
- 18 Other

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Element Data:

| | | | |
|-----------------------|------------------------|--------------------|--------------------------|
| Element Group: | Abutments | Length: | 0.00 |
| Element Name: | Abutment Walls | Width: | 5.50 |
| Location: | Each End | Height: | 3.00 |
| Material: | Cast-in-Place Concrete | Count: | 2.0 |
| Element Type: | Conventional Closed | Total Quantity: | 33.0 |
| Environment: | Benign | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 0.0 | 16.5 | 16.5 | 1 |

Comments: The east abutment wall is in fair condition with hairline to narrow map cracking throughout. Concrete deterioration and spalling was noted at each corner of the bearing seat. The west abutment wall is in poor condition with significant concrete deterioration and spalling. The west abutment has a wide vertical crack at each wingwall connection extending fully through the structure.

| | | | | | |
|---------------------|-------------------------------------|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Replace entire bridge substructure. | | | | |

| | | | |
|-----------------------|------------------------|--------------------|-------------------------------------|
| Element Group: | Abutments | Length: | 0.60 |
| Element Name: | Ballast Walls | Width: | 4.20 |
| Location: | | Height: | 0.30 |
| Material: | Cast-in-Place Concrete | Count: | 2.0 |
| Element Type: | - | Total Quantity: | 7.6 |
| Environment: | Severe | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 5.7 | 1.9 | 0.0 | |

Comments: Portions of ballast wall replaced in 2003 are in good condition. Remaining portions of ballast wall are in fair condition. Portions of ballast wall covered with formwork.

Recommend replacing entire bridge substructure. Costed under abutment wall.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|------------------|--------------------|--------------------------|
| Element Group: | Abutments | Length: | 0.18 |
| Element Name: | Bearings | Width: | 0.15 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 14.0 |
| Element Type: | Plate | Total Quantity: | 14.0 |
| Environment: | Moderate | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 0.0 | 0.0 | 14.0 | |

Comments: Bearing pads under stringers are in poor condition with significant corrosion and section loss.
Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|------------------------|--------------------|--------------------------|
| Element Group: | Abutments | Length: | 4.70 |
| Element Name: | Wingwalls | Width: | 1.00 |
| Location: | Each Quadrant | Height: | 2.30 |
| Material: | Cast-in-Place Concrete | Count: | 4.0 |
| Element Type: | Reinforced Concrete | Total Quantity: | 43.2 |
| Environment: | Benign | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 0.0 | 10.8 | 32.4 | 1 |

Comments: Northwest and southwest wingwalls are in poor condition with severe spalling and wide vertical cracks at abutment wall connection. Northeast wingwall is in poor condition with extensive map cracking with efflorescence. Southeast wingwall is in fair condition with light scaling and map cracking noted.
Recommend replacing entire bridge substructure. Costed under abutment wall.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|--------------------|--------------------|--------------------------|
| Element Group: | Accessories | Length: | 0.00 |
| Element Name: | Signs | Width: | 0.00 |
| Location: | Each Quadrant | Height: | 0.00 |
| Material: | Steel | Count: | 4.0 |
| Element Type: | - | Total Quantity: | 4.0 |
| Environment: | Moderate | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 4.0 | 0.0 | 0.0 | |

Comments:

4 hazard signs installed at bridge.

Recommend installing additional signage (narrow bridge, yield to oncoming traffic, etc.) at bridge. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|------------------------------|--------------------|--------------------------|
| Element Group: | Approaches | Length: | 112.00 |
| Element Name: | Barriers | Width: | 0.00 |
| Location: | Each Quadrant | Height: | 0.00 |
| Material: | | Count: | 1.0 |
| Element Type: | Steel Flex Beam on Wood Post | Total Quantity: | 112.0 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | Hot dip galvanizing | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 53.0 | 20.0 | 39.0 | 8 |

Comments:

Southwest has 10m of impact damage. Northwest has 2m of impact damage. Entire section of guiderail at southeast in poor condition. Posts in overall good to fair condition with signs of deterioration and rot.

| | | | | | |
|---------------------|---|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Replace guiderail system and install code compliant end treatments. | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|------------------------|--------------------|--------------------------|
| Element Group: | Approaches | Length: | 6.00 |
| Element Name: | Wearing Surface | Width: | 4.30 |
| Location: | | Height: | 0.00 |
| Material: | Gravel | Count: | 2.0 |
| Element Type: | - | Total Quantity: | 51.6 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 46.6 | 5.0 | 0.0 | |

Comments: East approach is gravel and in good condition. West approach is paved and in good to fair condition with ruts.

| | | | | | |
|---------------------|--|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Pave approaches and bridge deck top during bridge replacement. | | | | |

| | | | |
|-----------------------|----------------------|--------------------|--------------------------|
| Element Group: | Barriers | Length: | 34.70 |
| Element Name: | Hand Railings | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | Single Railing | Total Quantity: | 69.4 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 0.0 | 0.0 | 69.4 | 1 |

Comments: 2" tube railing in poor condition with several broken connections, deformations and impact damage. Railing has medium to severe corrosion throughout.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|------------------------------------|--------------------|--------------------------|
| Element Group: | Barriers | Length: | 37.70 |
| Element Name: | Railing Systems | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | Steel Flex Beam over Other Railing | Total Quantity: | 75.4 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | Hot dip galvanizing | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 0.0 | 75.4 | 0.0 | |

Comments:

Guide rail over bridge is in fair condition with localized impact damaged noted.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|--------------------|--------------------|-------------------------------------|
| Element Group: | Beams | Length: | 5.00 |
| Element Name: | Floor Beams | Width: | 0.14 |
| Location: | | Height: | 0.38 |
| Material: | Steel | Count: | 7.0 |
| Element Type: | I-Type | Total Quantity: | 35.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 5.0 | 7.5 | 22.5 | 1 |

Comments:

Floor beams are in fair to poor condition. First and third floor beam from west are in poor condition with severe corrosion and perforations noted. First floor beam from east is in poor condition with perforations and deep pitting noted. Second floor beam from west has been replaced during last rehabilitation. Limited inspection due to water level.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|-----------|--------------------|-------------------------------------|
| Element Group: | Beams | Length: | 37.70 |
| Element Name: | Stringers | Width: | 0.13 |
| Location: | | Height: | 0.21 |
| Material: | Steel | Count: | 7.0 |
| Element Type: | I-Type | Total Quantity: | 263.9 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 0.0 | 263.9 | 0.0 | |

Comments: Steel stringers are in fair condition with extensive light to medium surface corrosion. Stingers spaced at 0.62m. Limited inspection due to water level.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|---------------------|--------------------|-------------------------------------|
| Element Group: | Bracing | Length: | 0.00 |
| Element Name: | Bracing | Width: | 0.00 |
| Location: | Between floor beams | Height: | 0.00 |
| Material: | Steel | Count: | 8.0 |
| Element Type: | - | Total Quantity: | 8.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 0.0 | 4.0 | 4.0 | |

Comments: 1" diameter tube x-bracing installed between floor beams. X-bracing is in fair to poor condition with extensive medium corrosion. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|---------------------------|--------------------|--------------------------|
| Element Group: | Coatings | Length: | 0.00 |
| Element Name: | Structural Steel | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | | Count: | 1.0 |
| Element Type: | Epoxy Zinc/Epoxy/Urethane | Total Quantity: | 1.0 |
| Environment: | | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | All | 0.0 | 0.0 | 0.0 | 1.0 | |

Comments:

Structural steel coating is in poor condition with 95% section loss.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|-------------------------------------|--------------------|--------------------------|
| Element Group: | Decks | Length: | 37.70 |
| Element Name: | Deck Top | Width: | 4.30 |
| Location: | | Height: | 0.00 |
| Material: | Wood | Count: | 1.0 |
| Element Type: | Laminated Wood Decking - transverse | Total Quantity: | 162.1 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 116.1 | 40.0 | 6.0 | |

Comments:

2x6 laminated deck is in good to fair condition with signs of localized deterioration and rutting. Deck top replaced in 2003.

| | | | | | |
|---------------------|---|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal. | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | | | | |
|-----------------------|---|------|---------------|------------------|--------------------|-------------------------------------|
| Element Group: | Embankments & Streams | | | | Length: | 0.00 |
| Element Name: | Embankments | | | | Width: | 0.00 |
| Location: | | | | | Height: | 0.00 |
| Material: | Soil | | | | Count: | 4.0 |
| Element Type: | - | | | | Total Quantity: | 4.0 |
| Environment: | Moderate | | | | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | | | | |
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 4.0 | 0.0 | 0.0 | |
| Comments: | Embankments appear to be in good condition. Review limited due to heavy vegetation. | | | | | |
| Recommended Work: | Replace | | Maint. Needs: | Maint. Priority: | | |
| Recommended Timing: | <1 Year | | Maint. Desc.: | | | |
| Work Details: | Embankments to be excavated and reconstructed during bridge replacement. | | | | | |

| | | | | | | |
|-----------------------|--|------|---------------|------------------|--------------------|---------------------------|
| Element Group: | Embankments & Streams | | | | Length: | 0.00 |
| Element Name: | Streams and Waterways | | | | Width: | 0.00 |
| Location: | | | | | Height: | 0.00 |
| Material: | | | | | Count: | 1.0 |
| Element Type: | - | | | | Total Quantity: | 1.0 |
| Environment: | | | | | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | | | | |
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | All | 0.0 | 1.0 | 0.0 | 0.0 | |
| Comments: | Watercourse appears to be in good condition. | | | | | |
| Recommended Work: | | | Maint. Needs: | Maint. Priority: | | |
| Recommended Timing: | | | Maint. Desc.: | | | |
| Work Details: | | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|--|--------------------|-------------------------------------|
| Element Group: | Foundations | Length: | 0.00 |
| Element Name: | Foundation (below ground level) | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Cast-in-Place Concrete | Count: | 2.0 |
| Element Type: | Spread | Total Quantity: | 2.0 |
| Environment: | Benign | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 1.0 | 0.0 | 1.0 | |

Comments: Foundations are not visible but east appears to be stable. Stability of west foundation is questionable due to wide vertical cracks in wingwalls. Foundation construction method is currently unknown.

| | | | | | |
|---------------------|-----------------------------|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Replace bridge foundations. | | | | |

| | | | |
|-----------------------|-----------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 37.10 |
| Element Name: | Bottom Chords | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | - | Total Quantity: | 74.2 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 37.1 | 37.1 | 0.0 | |

Comments: 2 - L3x3x5/16 with steel straps. Bottom chord appears to be in good to fair condition with light to medium corrosion. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | | | | |
|-----------------------|--|------|---------------|-------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | | | | Length: | 0.00 |
| Element Name: | Connections | | | | Width: | 0.00 |
| Location: | | | | | Height: | 0.00 |
| Material: | Steel | | | | Count: | 1.0 |
| Element Type: | Riveted | | | | Total Quantity: | 1.0 |
| Environment: | Moderate | | | | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | | | | |
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | All | 0.0 | 0.0 | 1.0 | 0.0 | |
| Comments: | <p>Truss connections appear to be in good to fair connection with light to medium surface corrosion. Some connections have been permanently deformed. Limited inspection due to height restrictions.</p> <p>Recommend replacing entire bridge superstructure. Costed under deck top.</p> | | | | | |
| Recommended Work: | | | Maint. Needs: | | | Maint. Priority: |
| Recommended Timing: | None | | Maint. Desc.: | | | |
| Work Details: | | | | | | |

| | | | | | | |
|-----------------------|--|------|---------------|-------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | | | | Length: | 42.30 |
| Element Name: | Top Chords | | | | Width: | 0.36 |
| Location: | | | | | Height: | 0.21 |
| Material: | Steel | | | | Count: | 2.0 |
| Element Type: | Channel | | | | Total Quantity: | 84.6 |
| Environment: | Moderate | | | | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | | | | |
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 42.3 | 39.3 | 3.0 | |
| Comments: | <p>Back-to-back c-channels (8x2x1/4) with steel top plate. Top chord is in good to fair condition with extensive light to medium surface corrosion and pitting. Minor impact damage noted at southeast and northwest. Top plate is exhibiting rolling due to corrosion. Limited inspection due to height restrictions.</p> <p>Recommend replacing entire bridge superstructure. Costed under deck top.</p> | | | | | |
| Recommended Work: | | | Maint. Needs: | | | Maint. Priority: |
| Recommended Timing: | None | | Maint. Desc.: | | | |
| Work Details: | | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|---------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 7.00 |
| Element Name: | Verticals/Diagonals | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 20.0 |
| Element Type: | - | Total Quantity: | 20.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 9.0 | 9.0 | 2.0 | |

Comments: Size of diagonal bracing varies based on location. Diagonal bracing is generally in good to fair condition with extensive light to medium surface corrosion. Diagonal brace at northeast is permanently deformed. Bottom connection of diagonal brace at southeast is permanently deformed. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|--------------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 5.20 |
| Element Name: | Verticals/Diagonals | Width: | 0.00 |
| Location: | Vertical Bracing at Ends | Height: | 0.00 |
| Material: | Steel | Count: | 14.0 |
| Element Type: | - | Total Quantity: | 14.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 6.0 | 6.0 | 2.0 | |

Comments: Size of vertical bracing varies. Bracing is generally in good to fair condition with extensive light to medium surface corrosion. Vertical brace at southwest and northeast permanently deformed. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Repair / Rehabilitation Required

| Element Group | Element | Repair / Rehabilitation | Priority | Const Cost |
|-----------------------|---------------------------------|---|----------|------------|
| Abutments | Abutment Walls | Replace entire bridge substructure. | <1 Year | \$75,000 |
| Approaches | Barriers | Replace guiderail system and install code compliant end treatments. | <1 Year | \$39,000 |
| Approaches | Wearing Surface | Pave approaches and bridge deck top during bridge replacement. | <1 Year | \$10,000 |
| Decks | Deck Top | Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal. | <1 Year | \$720,000 |
| Embankments & Streams | Embankments | Embankments to be excavated and reconstructed during bridge replacement. | <1 Year | \$80,000 |
| Foundations | Foundation (below ground level) | Replace bridge foundations. | <1 Year | \$79,000 |

Total Repair/Rehabilitation Cost \$1,003,000

Associated Work

| | Comments | Estimated Cost |
|------------------------------------|--|--------------------|
| Approaches | | \$0 |
| Detours | | \$0 |
| Traffic Control | <i>Traffic Control and Signage</i> | \$10,000 |
| Utilities | | \$0 |
| Right-of-Way | | \$0 |
| Environmental Study | | \$0 |
| Other | <i>Site Mob. And Demob., Environmental Protection and Dewatering</i> | \$130,000 |
| Contingencies | | 10.00% \$114,000 |
| Engineering | | 10.00% \$114,000 |
| Total Associated Work Cost | | \$368,000 |
| Total Repair / Rehabilitation Cost | | \$1,003,000 |
| Total Cost | | \$1,371,000 |

Justification

Due to the current condition of the bridge, we are recommending that the structure be removed or replaced within 1 year. It is our opinion that performing any major repairs to this structure would only delay the structure's eventual closure/replacement and would not be financially beneficial to the Municipality.

The Municipality of Brockton has retained GM BluePlan Engineering to complete a Municipal Class Environmental Assessment (Schedule 'B') on the structure to determine the impacts to the surrounding environment, including local agricultural and residential communities, if the following solutions are implemented:

- a) Permanent Bridge Removal (\$ 347,000)
- b) One-Lane Bridge Replacement (\$ 1,371,000)
- c) Two-Lane Bridge Replacement (\$ 1,665,000)

It should be noted that cost estimates provided have been prepared with limited design details and are based on probable conditions affecting the project. Therefore, cost estimates are intended to reflect the approximate magnitude of the project costs. A more detailed assessment of the overall project costs will be completed as part of the design phase once a preferred solution has been identified. The cost estimates do not include any major roadway work that may be required if the bridge is replaced.

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

In the meantime, it is our opinion that the condition of the steel stringers and west abutment wall are severe which has reduced the overall structural capacity of the bridge. Although a load evaluation would need to be completed to confirm, we believe that the current load limit is no longer appropriate. Therefore, we are recommending that the bridge be closed to all traffic as soon as possible until construction can be scheduled in 2021.

Ontario Structure Inspection Manual - Inspection Form

Structure Name

Site Number:

Structure ID:

Inspection Photos



View of structure looking southeast.



View of structure looking west



View of soffit looking east.



View of deck top looking east.



Localized deterioration of deck top.



Severe corrosion and deformations at railing system.

Ontario Structure Inspection Manual - Inspection Form

Structure Name **Riversdale Bridge**

Site Number: **0002**

Structure ID: **1**



Impact damage on top chord at southeast.



Permanent deformation of vertical web at northeast.



Impact damage on diagonal brace at southeast.



Impact damage and rotation of southeast guide rail.



View of east abutment wall.



View of west abutment wall.



Map cracking with efflorescence at northeast wingwall.



Severe spalling at northeast bearing seat.



Wide vertical crack with daylight at northwest wingwall.



Void in approach at northwest due to wingwall crack.



Wide vertical crack at southwest wingwall.



Severe corrosion and section loss of east bearing pad.



Severe section loss and large perforations at west stringer.



Severe section loss and large perforations at west stringer

D.7 – STRUCTURES AND CLEARANCES

D.7.1 – INTRODUCTION

The material contained in this section is intended to assist the road designer when designing cross sections where bridge structures, retaining walls or other structures are required. The section gives direction in setting structure dimensions of an operational nature or structural dimensions that influence geometric design of horizontal alignment, vertical alignment and cross sections. For additional detailed information and structural dimensions, reference should be made to the current edition of the Ontario Highway Bridge Design Code.

D.7.2 – BRIDGE TYPES

A bridge is a structure having a span of 3 m or more which either forms a part of a highway or passes over or under the highway.

A bridge should be designed to suit the geometric requirements of the road, however, in designing the geometric features of a road the impact of the geometry on structural design should be taken into account.

Modern bridges are constructed of wood, reinforced concrete, prestressed concrete, or steel. The approximate range of spans over which general structure types have been found to be suitable is given in Table D.7-1.

Bridges in common use are generally slab, voided slab, beam and truss bridges. The many structural configurations available make it difficult to set general guidelines for estimating structure depth; however, in setting preliminary grade line at a grade separation structure, the following rules of thumb may be used for the total thickness of girder and deck (otherwise known as the structure depth):

- for railway structures use 11% of the total span,
- for highway bridges use 7% of the total span.

Bridge structures for grade separations and most water crossings should conform in alignment, profile and cross section to the natural lines of the approaches.

Bridges spanning roadways should be of deck type construction rather than truss as they have a pleasing appearance and can be more easily widened later. Overhead bridges may have a single or double opening for the two roadways and may have either open or closed abutments (see Figure D.7-1).

Bridges with open abutments are preferable to closed abutments as they provide better visibility. Where the clearances are minimal, guide rail protection must be considered.

Closed abutments are adaptable to narrow rights-of-way but should be provided with independently supported guide rail protection placed a minimum of 1.0 m from the face of the guide rail to the wall or pier.

Table D.7-1

SPAN LENGTHS FOR BRIDGE STRUCTURES

| Type | Material | Span Range m |
|--------------|----------------------|-----------------|
| Slab | Reinforced Concrete | 3-15 |
| | Prestressed Concrete | 3-30 |
| Voided Slab | Prestressed Concrete | 30-70 |
| Beam | Wood | 3-6 |
| | Prestressed Concrete | 10-55 |
| | Steel | 10-160 |
| Truss | Steel | 90-550 |
| Arch Rib | Concrete | 90-330 |
| | Steel | 120-370 |
| Arch Truss | Steel | 240-520 |
| Cable Stayed | Prestressed Concrete | 90-400 |
| | Steel | 90-400 |
| Segmental | Prestressed Concrete | 50-230 |
| Suspension | Steel | 300-1500 |

It is desirable that the full shoulder width be carried across bridges in order to eliminate the hazard of the offsets at the ends of the bridge and to provide a refuge for disabled vehicles. However, this is not always practical and shoulder widths should be modified as stated in Section D.7.3.2.

For long bridges, particularly long-span bridges where costs are high, some shoulder width restriction is necessary. The effect of the restriction is compensated to some extent by the tendency of drivers to be more alert and to become accustomed to the reduced clearance.

Bailey Bridges and Acrow Panel Bridges are modular steel panel bridges which can be quickly assembled and erected. They are used for detours, temporary crossings and for emergency applications.

D.7.3 – CROSS SECTION DIMENSIONS

D.7.3.1 – Deck Width and Traffic Lanes

The number and width of through lanes and auxiliary lanes should be the same on the bridge deck as on the approach roadway.

In general, the minimum acceptable bridge cross section is 8.5 m. Provision of single-lane bridges may be permitted on very low-volume roadways in which the minimum width between curbs, railings or curb and railing should not be less than 5.0 m.

D.7.3.2 – Bridge Deck Shoulder Widths

For a bridge where the approach roadway is provided with continuous barrier walls or curbs, and

ROAD ALLOWANCE:

Means a surveyed allowance of land for roadway purposes. A road allowance can be either “opened” with an existing road surface or “unopened” in which case no travelled surface is provided.

In this document, “existing road allowance” means an existing opened road allowance with an existing road surface, or road right-of-way. It does not include an unopened or shore road allowance.

ROAD CAPACITY:

Means capacity defined in terms of travelled lanes and does not differentiate between various lane widths to accommodate differing volumes of traffic.

ROAD WIDENING:

Means increasing the number of lanes of an existing road and may include the widening of the right-of-way but does not include localized operational improvements.

ROADS:**Arterial Roads:**

Means roads which move moderate to high traffic volumes over moderate distances within a municipality between principal areas of traffic generation and which gather traffic from collector roads and local roads and move it to the Provincial highway system; arterial roads are generally designed for medium speed, have capacity for 2 - 6 lanes, may be divided, with limited or controlled direct access from adjacent developments and with on-street parking discouraged.

Collector Roads:

Means roads which move low to moderate traffic volumes within specific areas of a municipality and collect local traffic for distribution to the arterial or Provincial highway system; collector roads are generally designed for medium speed, have capacity for 2 - 4 lanes, are usually undivided, with direct access from adjacent development permitted but usually controlled, and with controlled on-street parking usually permitted.

Local Roads:

Means roads which provide for low volumes of traffic and access to private properties; local roads are designed for low speeds, have capacity for 2 undivided lanes of traffic; through traffic is discouraged and parking is usually permitted though often controlled.

**SAME PURPOSE, USE,
CAPACITY AND LOCATION:**

See Operation.

**SAME PURPOSE, USE AND
LOCATION (TRANSIT
PROJECTS):**

See Section D.1.3.1.

Table D.A-2

GEOMETRIC DESIGN STANDARDS FOR SECONDARY HIGHWAYS

| DESIGN ELEMENTS DESIGN YEAR TRAFFIC VOLUME | | DESIGN SPEED | MINIMUM CURVES (m) | | | MINIMUM STOPPING SIGHT DIST. | MAX. GRADE | WIDTH (m) | |
|--|------------------|--------------|--------------------|-----------|---------|------------------------------|------------|-----------|----------|
| | | | HORIZ. | VERTICAL | | | | | |
| AADT | DHV | km/h | Radius | K - Crest | K - Sag | m | % | Lane | Shoulder |
| Greater than 1000 | Greater than 150 | 100 | 420 | 70 | 45 | 185 | 6 - 8 | 3.50 | 2.00 |
| | | 90 | 340 | 50 | 40 | 160 | 6 - 8 | 3.25 | 2.00 |
| | | 80 | 250 | 35 | 30 | 135 | 6 - 8 | 3.25 | 2.00 |
| | | 70 | 190 | 25 | 25 | 110 | 6 - 12 | 3.00 | 1.00 |
| | | 60 | 130 | 15 | 18 | 85 | 6 - 12 | 3.00 | 1.00 |
| 1000 to 400 | 150 to 60 | 80 | 250 | 35 | 30 | 135 | 6 - 8 | 3.25* | 1.00 |
| | | 70 | 190 | 25 | 25 | 110 | 6 - 12 | 3.00 | 1.00 |
| | | 60 | 130 | 15 | 18 | 85 | 6 - 12 | 3.00 | 1.00 |
| Less than 400 | Less than 60 | 80 | 250 | 35 | 30 | 135 | 8 | 3.25* | 1.00** |
| | | 70 | 190 | 25 | 25 | 110 | 12 | 3.00 | 1.00** |
| | | 60 | 130 | 15 | 18 | 85 | 12 | 3.00 | 1.00** |
| | | 50 | 90 | 8 | 12 | 65 | 12 | 2.75 | 1.00** |

Lane width may be increased by 0.25 m to a maximum of 3.5 m if warranted by type, size and volume of truck traffic.

* A 3.0 m lane width may be acceptable where the type, size and volume of trucks are not significant.

** 0.5 m shoulders will be permitted where there is no foreseeable possibility of the road being paved within a 20-year period. A minimum of 1.0 m shoulder must be used where guide rail is installed.

Notes:

- Design Year should reflect the anticipated life span of the proposed improvement. Design Year is normally 10 years beyond the Program Year for resurfacing and reconstruction projects, and 20 years beyond for new construction projects.
- Use DHV if available for selection of design standards.
- Desirable Maximum Design Speed is 80 km/h.
- Minimum Horizontal Curve Radius based on maximum superelevation of 0.06 m/m.
- Minimum Vertical Curve Standards based on stopping sight distance.
- Lower value in maximum grade range is desirable maximum. Higher value is acceptable maximum.
- Minimum desirable shoulder width for:
 - pavement support - 1.0 m gravel shoulder
 - 0.5 m paved shoulder
 - disabled vehicle - 2.0 m shoulder
- Desirable Shoulder Rounding - 0.5 m.

A.5.7 DESIGN SPEED SELECTION

Many factors influence and constrain the selection of the appropriate design speed for a given highway facility, which include:

- traffic conditions, such as volumes, composition and trip length
- character of terrain
- socio-economic-political characteristics of the area, i.e. population density and land development and travel habits of the local residents
- environmental quality and aesthetics
- economics

Application of these criteria applies only to the selection of a specific design speed within the logical range of values pertinent to the classification type selected. The ranges for each classification are illustrated in Table A5-2.

Traffic volumes are instrumental in the selection of the appropriate classification from the eight basic types, as well as in the selection of road cross-sectional features and intersection/interchange design which affect the capacity and level of service.

The effects of terrain types, socio-economic characteristics, environment and economics are not immediately obvious.

The typical driver can recognize or sense a logical operating speed for a given highway based on knowledge of the system, appraisal of the ruggedness of the terrain, and the extent, density and size of development. Based on this judgement, the driver will adjust speed to be consistent with the conditions expected to be encountered. The driver's initial response is to react to the anticipated situation rather than to the actual situation. In most instances, the two are similar enough that no problems are created. When the initial response is incorrect, operation and safety may be severely affected.

Design speed should be chosen to be consistent with the speed a driver is likely to expect. Where a difficult condition is obvious, drivers are more inclined to accept lower speed operation than where there is no apparent reason for it.

Other things being equal, it follows that a highway in level or rolling terrain justifies a higher design speed than one in mountainous terrain, and a highway located in a rural environment calls for a higher design speed than one situated in an urban area.

A highway carrying a large volume of traffic may justify a higher design speed than a less important facility in similar topography, particularly where the savings in vehicle operation and other operating costs are sufficient to offset the increased costs of right-of-way and construction. A low design speed, however, should not automatically be assumed for a secondary highway where the topography is such that drivers are likely to travel at high speeds. Drivers do not adjust their speeds to the importance of the highway but to its physical limitations and the traffic thereon.

When the appropriate highway classification division is selected from Table A5-1, the design speed can be chosen from the range of values in Table A5-2.

When designing a substantial length of highway, it is desirable, although it may not be feasible, to assume a constant design speed. Changes in terrain and other physical controls may dictate a change in design speed on certain sections. Each section, however, should be of relatively long length, compatible with the general terrain or development through which the highway passes. The justification for introducing a reduced design speed should be obvious to the driver. Moreover, the introduction of a lower or higher design speed should not be effected abruptly but over sufficient distance to permit drivers to change speed gradually before reaching the section of highway with the different design speed.

Differences in design speed from one segment to another should not be more than 20 km/h. Even so, drivers may not perceive the slower condition ahead, for which they should be warned well in advance. A transition section allowing for speed reductions, as from 100 to 90 to 80 km/h should be provided. Thus, the changing condition should comprise extra long (anticipatory) sight distances, speed-zone signs, curve speed signs, and so on.

Design speed should be greater than or equal to the legal posted speed.

Generally the desirable practice of selecting the design speed for new construction and reconstruction is

- 20 km/h greater than the proposed legal speed, unless circumstances warrant a reduction.

A design speed equal to the maximum posted speed is accepted where warranted by such factors as low traffic volumes, rugged terrain and economic considerations. This practice would be more appropriate for minor collector and local roads. A design speed equal to the legal posted speed is the normal practice for Secondary Highways.

Where a highway section warrants only resurfacing to remove pavement structure deficiencies, the general practice is to limit construction costs by removing only



critical deficiencies as identified by the accident and maintenance records. The existing alignment is generally retained. In these situations the proposed and the existing design speeds should be the same.

Commonly used design speeds are:

- 120 km/h for freeways
- 110 km/h for major arterials carrying long distance traffic, and all four-lane divided and undivided highways
- 100 km/h for all other arterials and collectors
- 80 km/h for local roads and secondary highways.

Horizontal and vertical alignment geometry should be consistent with the selected design speed. In practice, because of numerous constraints often encountered, minimum acceptable values for alignment standards are recognized and used.

Minimum acceptable standards are based on the allowable reduction in the design speed of isolated curves from the overall design speed of the highway.

The reduction should preferably be no greater than 10 km/h and never greater than 20 km/h.

Where higher than average accident rates can be attributed to geometric design deficiencies, corrective measures should be considered. Isolated deficiencies should be improved if signing alone proves to be ineffective and costs are acceptable.

Where a minor secondary highway has a generally substandard alignment and advisory and warning signs have proven ineffective, consider:

- where no improvements are warranted - reducing the legal posted speed to be consistent with the overall highway design speed; or
- where improvements are warranted - selecting a design speed and corresponding legal posted speed commensurate with the topography and with a realistic balance between improvement costs and user benefits.

The implications of employing substandard curvature are more fully explained in Chapter C - ALIGNMENT.

Design speeds have been established in 10 km/h increments, ranging from 40 km/h for local roads, to a maximum of 120 km/h for design of freeways. Maximum and minimum design speeds have been established for each major classification of highway. The resulting functional classification system is presented in Table A5-2.

1.4 RISK ACCEPTANCE

The alternative to removing, replacing or shielding hazards is to accept some risk. The risk acceptance alternate is usually the best choice when the cost of other acceptable alternates outweigh the potential benefits of reduced accident severity. Although other criteria might indicate a need for corrective action, if funds for safety improvements are limited, it will be a prudent alternative to accept the risk at low priority locations so available funds can be concentrated where they will achieve the greatest safety return. This alternative increases in acceptability when there is a long record showing little or no run-off-the-road impacts, and where there is a low possibility of future accidents. On the other hand, risk acceptance may be unacceptable in the event of a clear accident pattern or if future accidents appear likely.

The suitability of the risk acceptance alternative is a function of accident history and the possibility of future accidents. The accident history should consider multiple years of run-off-the-road impacts with the hazard in question. Unfortunately, we do not have a fully satisfactory basis to evaluate the possibility of future accidents. In the final analysis, this judgement must be made on the basis of personal knowledge and professional assessment of the hazard, roadway, site and traffic conditions.

If it is decided not to follow policy but to accept risk, approval of the Design Criteria Committee is required. Reasons for risk acceptance must be documented in the project file.

**PRELIMINARY COST ESTIMATE
GREENOCK BRIDGE 0002
MUNICIPALITY OF BROCKTON
SINGLE SPAN, SINGLE LANE REPLACEMENT**

| Item No. | Description | Qty. | Unit of Measure | Unit Price | Total Price |
|--|---|------|-----------------|---------------|------------------------|
| Anticipated 2020 Cost | | | | | |
| 1 | Bonding, Insurance, Mobilization and Demobilization | 100% | L.S. | \$ 85,000.00 | \$ 85,000.00 |
| 2 | Environmental Protection | 100% | L.S. | \$ 20,000.00 | \$ 20,000.00 |
| 3 | Temporary Signage & Traffic Control | 100% | L.S. | \$ 10,000.00 | \$ 10,000.00 |
| 4 | Clearing and Grubbing | 100% | L.S. | \$ 10,000.00 | \$ 10,000.00 |
| 5 | Excavation at Structure | 100% | L.S. | \$ 30,000.00 | \$ 30,000.00 |
| 6 | Removal and Disposal of Existing Structure | 100% | L.S. | \$ 120,000.00 | \$ 120,000.00 |
| 7 | Dewatering | 100% | L.S. | \$ 25,000.00 | \$ 25,000.00 |
| 8 | Supply and Place Concrete for Mudslabs | 10 | m ³ | \$ 400.00 | \$ 4,000.00 |
| 9 | Supply and Install Concrete Footings | 50 | m ³ | \$ 1,500.00 | \$ 75,000.00 |
| 10 | Supply and Install Concrete Wingwall and Abutments | 50 | m ³ | \$ 1,500.00 | \$ 75,000.00 |
| 11 | Provide and Install Pre-Eng Steel Bridge | 100% | L.S. | \$ 600,000.00 | \$ 600,000.00 |
| 12 | Supply and Place Granulars | 1000 | tonne | \$ 25.00 | \$ 25,000.00 |
| 13 | Supply and Install Guide Rail System on Approaches | 120 | m | \$ 180.00 | \$ 21,600.00 |
| 14 | Supply and Install Guide Rail End Treatment | 4 | each | \$ 4,200.00 | \$ 16,800.00 |
| 15 | Supply and Place Asphalt on Deck Top | 25 | tonne | \$ 250.00 | \$ 6,250.00 |
| 16 | Supply and Place Asphalt on Approaches | 15 | tonne | \$ 250.00 | \$ 3,750.00 |
| 17 | Site Restoration | 100% | L.S. | \$ 15,000.00 | \$ 15,000.00 |
| ESTIMATED TOTAL CONSTRUCTION COST | | | | | \$ 1,142,400.00 |
| CONTINGENCY ALLOWANCE (10%) | | | | | \$ 114,300.00 |
| ENGINEERING AND CONTRACT ADMINISTRATION | | | | | \$ 114,300.00 |
| PROJECT TOTAL | | | | | \$ 1,371,000.00 |

Note: 1. Foundation cost to be confirmed by Geotechnical Investigation. Deep foundations have not been considered
2. Cost estimate has not considered utility modifications.
3. Cost estimate based on prefabricated superstructure. Cost estimate could vary depending on proposed construction method.

**PRELIMINARY COST ESTIMATE
GREENOCK BRIDGE 0002
MUNICIPALITY OF BROCKTON
SINGLE SPAN, TWO LANE BRIDGE REPLACEMENT**

| Item No. | Description | Qty. | Unit of Measure | Unit Price | Total Price |
|------------------------------|---|------|-----------------|---------------|---------------|
| Anticipated 2020 Cost | | | | | |
| 1 | Bonding, Insurance, Mobilization and Demobilization | 100% | L.S. | \$ 105,000.00 | \$ 105,000.00 |
| 2 | Environmental Protection | 100% | L.S. | \$ 20,000.00 | \$ 20,000.00 |
| 3 | Temporary Signage & Traffic Control | 100% | L.S. | \$ 10,000.00 | \$ 10,000.00 |
| 4 | Clearing and Grubbing | 100% | L.S. | \$ 15,000.00 | \$ 15,000.00 |
| 5 | Excavation at Structure | 100% | L.S. | \$ 30,000.00 | \$ 30,000.00 |
| 6 | Removal and Disposal of Existing Structure | 100% | L.S. | \$ 120,000.00 | \$ 120,000.00 |
| 7 | Dewatering | 100% | L.S. | \$ 40,000.00 | \$ 40,000.00 |
| 8 | Supply and Place Concrete for Mudslabs | 15 | m ³ | \$ 400.00 | \$ 6,000.00 |
| 9 | Supply and Install Concrete Footings | 80 | m ³ | \$ 1,500.00 | \$ 120,000.00 |
| 10 | Supply and Install Concrete Wingwalls and Abutments | 80 | m ³ | \$ 1,500.00 | \$ 120,000.00 |
| 11 | Supply and Place Precast Girders | 5 | Each | \$ 70,000.00 | \$ 350,000.00 |
| 12 | Supply and Install Reinforced Concrete Deck | 75 | m ³ | \$ 2,000.00 | \$ 150,000.00 |
| 13 | Supply and Install Reinforced Concrete Curbs | 10 | m ³ | \$ 1,500.00 | \$ 15,000.00 |
| 14 | Supply and Install Approach Slabs | 16.8 | m ³ | \$ 1,500.00 | \$ 25,200.00 |
| 15 | Supply and install Expansion Joints | 16 | m | \$ 2,000.00 | \$ 32,000.00 |
| 16 | Supply and Install Elastomeric Bearing Pads | 10 | Each | \$ 1,500.00 | \$ 15,000.00 |
| 17 | Supply and Install Deck Drains | 4 | Each | \$ 1,500.00 | \$ 6,000.00 |
| 18 | Deck Railing System | 75 | m | \$ 1,000.00 | \$ 75,000.00 |
| 19 | Deck Waterproofing | 265 | m ² | \$ 65.00 | \$ 17,225.00 |
| 20 | Supply and Place Granulars | 1500 | tonne | \$ 25.00 | \$ 37,500.00 |
| 21 | Supply and Install Guide Rail System on Approaches | 120 | m | \$ 180.00 | \$ 21,600.00 |
| 22 | Supply and Install Guide Rail End Treatment | 4 | each | \$ 4,200.00 | \$ 16,800.00 |

| Item No. | Description | Qty. | Unit of Measure | Unit Price | Total Price |
|--|--|------|-----------------|--------------|------------------------|
| Anticipated 2020 Cost | | | | | |
| 23 | Supply and Place Asphalt Wearing Surface | 60 | tonne | \$ 250.00 | \$ 15,000.00 |
| 24 | Supply and Place Asphalt on Approaches | 20 | tonne | \$ 250.00 | \$ 5,000.00 |
| 25 | Site Restoration | 100% | L.S. | \$ 20,000.00 | \$ 20,000.00 |
| ESTIMATED TOTAL CONSTRUCTION COST | | | | | \$ 1,387,325.00 |
| CONTINGENCY ALLOWANCE (10%) | | | | | \$ 138,800.00 |
| ENGINEERING AND CONTRACT ADMINISTRATION | | | | | \$ 138,800.00 |
| PROJECT TOTAL | | | | | \$ 1,664,925.00 |

Note: 1. Foundation cost to be confirmed by Geotechnical Investigation. Deep foundations have not been considered.
2. Cost estimate has not considered possible roadway widening requirements.
3. Cost estimate has not considered utility modifications.
4. Cost estimate based on cast-in-place superstructure. Cost estimate could vary depending on proposed construction method.

**PRELIMINARY COST ESTIMATE
GREENOCK BRIDGE 0002
MUNICIPALITY OF BROCKTON
BRIDGE REMOVAL**

| Item No. | Description | Qty. | Unit of Measure | Unit Price | Total Price |
|--|---|------|-----------------|--------------|----------------------|
| Anticipated 2020 Cost | | | | | |
| 1 | Bonding, Insurance, Mobilization and Demobilization | 100% | L.S. | \$ 20,000.00 | \$ 20,000.00 |
| 2 | Environmental Protection | 100% | L.S. | \$ 10,000.00 | \$ 10,000.00 |
| 3 | Temporary Signage & Traffic Control | 100% | L.S. | \$ 7,500.00 | \$ 7,500.00 |
| 4 | Clearing and Grubbing | 100% | L.S. | \$ 7,500.00 | \$ 7,500.00 |
| 5 | Existing Bridge Structure Removal | 100% | L.S. | \$ 90,000.00 | \$ 90,000.00 |
| 6 | Partial Removal of Abutments and Wingwalls | 100% | L.S. | \$ 35,000.00 | \$ 35,000.00 |
| 7 | Excavation and Grading | 100% | L.S. | \$ 20,000.00 | \$ 20,000.00 |
| 8 | 500mm Rip-Rap with Geotextile | 250 | m ² | \$ 90.00 | \$ 22,500.00 |
| 9 | Embankment Restoration at Bridge | 100% | L.S. | \$ 15,000.00 | \$ 15,000.00 |
| 10 | Turnaround Construction | 100% | tonne | \$ 40,000.00 | \$ 40,000.00 |
| 11 | Dead End Signage and Guide Rail Barrier | 100% | L.S. | \$ 10,000.00 | \$ 10,000.00 |
| ESTIMATED TOTAL CONSTRUCTION COST | | | | | \$ 277,500.00 |
| CONTINGENCY ALLOWANCE (10%) | | | | | \$ 27,800.00 |
| ENGINEERING AND CONTRACT ADMINISTRATION | | | | | \$ 41,700.00 |
| PROJECT TOTAL | | | | | \$ 347,000.00 |

May 11, 2020
Our File: 212326

Via Email: jstrader@brockton.ca

Municipality of Brockton
100 Scott Street, Box 68
Walkerton, ON N0G 2V0

Attention: Mr. John Strader

Re: Bridge Condition Assessment
Greenock Bridge Structure. No. 2 -
Riversdale Bridge
Municipality of Brockton

Dear John,

Pursuant to your request, the undersigned attended the above noted site on March 24, 2020 to review the condition of the Riversdale Bridge located on the Side Road 20. The single span bridge consists of a steel truss superstructure supported at each end by concrete abutments. The structure is included in the 2020 Bridge Inspection Program for the Municipality of Brockton (Municipality) which has been completed GM BluePlan Engineering (GMBP) since 1977. Based on our records, the bridge structure has been recommended for replacement since our 2014 report and has received repairs in 2003 and 2008 which included replacement of several steel truss members, steel stringers, some of the steel cross beams, and the timber deck.

Currently, the Municipality has retained GM BluePlan Engineering Limited (GMBP) to complete a Municipal Class Environmental Assessment (MCEA) on the bridge to determine the most suitable alternative for this river crossing (including replacement, rehabilitation or permanent closure). It is expected that the MCEA will be completed by the end of 2020 allowing the project to move forward to the detailed design and construction phase in 2021.

A load evaluation was completed on the bridge in 2016 by GMBP which determined that the existing triple load posting (8, 13, 21 tonnes) was appropriate at that time. A report was provided to the Municipality dated January 13, 2017 outlining the results of the load evaluation and recommending that the bridge be re-evaluated in 2019 (not completed).

Based on our recent site visit, the condition of the bridge structure has continued to deteriorate since the last load evaluation in 2016. Overall, the steel superstructure is in fair to poor condition with extensive surface corrosion throughout and signs of permanent deformation of secondary support members (vertical and diagonal webs). The steel floor beams supporting the deck are in poor condition with severe corrosion and section loss noted. The first and third floor beam from the west have large perforations in the web and have significant section loss along the top flange. The west abutment wall and wingwalls are in poor condition with severe concrete spalling and deterioration. Wide vertical cracks have been noted at each end of the abutment (adjacent to the wingwalls) extending from grade to the top of the wall. It is expected that the cracks in the abutment extend fully through the thickness of the wall.

Given that the upcoming construction schedule (2021) and the low traffic volume on the bridge, it is our opinion that performing an additional load evaluation on the structure in 2020 would not be cost beneficial to the Municipality. We expect that the new load evaluation would result in a similar conclusion (i.e. bridge closure) or at the very least, would impose a significantly lower load limit on the bridge. Since the bridge is located in an agricultural community which utilizes heavy farm equipment, it is our opinion that a reduced load posting would be impractical, and would offer little benefit to light vehicle traffic. Based on the condition of the structure, we are recommending that the bridge be closed to all vehicle traffic until remedial work can be completed.

Pedestrian and all-terrain vehicles may continue to use the bridge when there is no snow accumulation on the deck. However, during the winter months, a significant weight of snow could accumulate on the deck, rendering the bridge unsafe, unless the snow is cleared regularly with a light blower or plow.

Should you have any questions, please do not hesitate to contact me, and thank you for choosing GM BluePlan Engineering for your engineering needs.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in blue ink, appearing to read 'Jesse Borges'.

Jesse Borges, P.Eng.
JB/mr



cc: Municipality: Gregory Furtney - gfurtney@brockton.ca
GMBP: Brent Willis, P.Eng. - brent.willis@gmblueplan.ca
File No. 212326

APPENDIX D:
TRAFFIC IMPACT ASSESSMENT (PARADIGM)

17 April 2018
Project: 180043

John Slocombe
GM BluePlan Engineering Limited
1260 2nd Avenue East
Owen Sound, ON N4K 2J3

Dear Mr. Slocombe:

**RE: RIVERSDALE BRIDGE NO. 2 EA STUDY – TRANSPORTATION IMPACT STUDY
BROCKTON, BRUCE COUNTY**

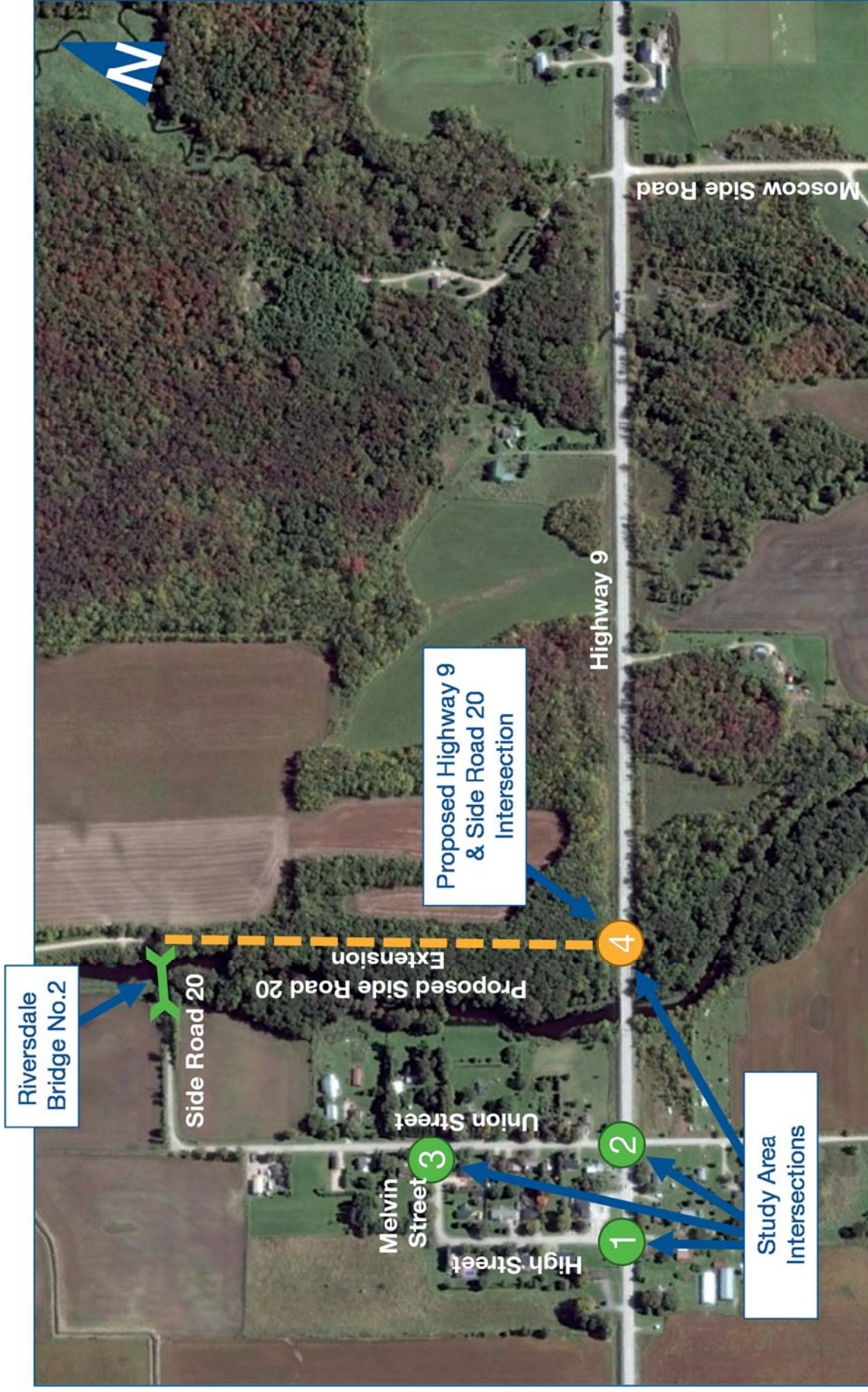
Paradigm Transportation Solutions Limited (Paradigm) has been retained by the Municipality of Brockton (the Client) to carry out a Transportation Impact Study to provide background information prior to the Municipality undertaking a Municipal Class Environmental Assessment (EA) to address an aging heritage bridge in Riversdale, located on Side Road 20, to the north of Highway 9. The Municipality has retained GM BluePlan Engineering Limited (GMBP) to carry out the EA Study. The purpose of undertaking the TIS prior to the EA process is to determine the technical feasibility of some of the potential alternatives that may be considered in the EA.

Project Background

The Riversdale community is located west of Walkerton, at the crossing of Highway 9 and the Teeswater River. The Riversdale Bridge (aka. Greenock Bridge No.0002) is an aging steel pony truss bridge located on Side Road 20, to the north of Highway 9, within Lot 30, Concession 1N in the former Township of Greenock, Municipality of Brockton. The subject bridge is part of Side Road 20 West and crosses the Teeswater River immediately to the northeast of the Village of Riversdale. The following potential alternatives were proposed to be addressed in the TIS:

- ▶ **Road Realignment:** Close Bridge No. 0002 to vehicular traffic (i.e. removal or adaptive re-use) with road realignment of Side Road 20 directly south to a new intersection Highway 9; and
- ▶ **Maintain Bridge Crossing:** Reconstruct or re-habilitate Bridge No. 0002 and maintain the existing road alignment across the Teeswater River.

The above-noted alternatives require Ministry of Transportation Ontario (MTO) review including an assessment of the traffic impacts and feasibility of a new intersection on Highway 9. This would involve assessing the technical feasibility of closing Bridge No.0002 (Riversdale) to vehicular traffic and re-routing the road parallel to the river to a new intersection with Highway 9., including the assessment of the traffic impacts and feasibility of providing a new intersection on Highway 9, east of the existing Highway 9 Bridge on the Teeswater River. **Figure 1** details the study area and proposed road extension.



Study Area

Traffic Volumes

On Wednesday, March 7, 2018 AM (6:00 to 9:00) and PM (3:00 to 6:00) peak period intersection turning movement data were collected using Miovision cameras at the following study area intersections:

- ▶ Highway 9 at Union Street (two-way Stop-controlled);
- ▶ Highway 9 at High Street (two-way Stop-controlled);
- ▶ Union Street at Melvin Street (two-way Stop-controlled); and
- ▶ Side Road 20 on the subject bridge.

Figure 2 and **Figure 3** summarize the existing AM and PM peak hour traffic volumes, respectively. **Attachment A** provides the count data and signal timings.

Pre-Consultation with MTO

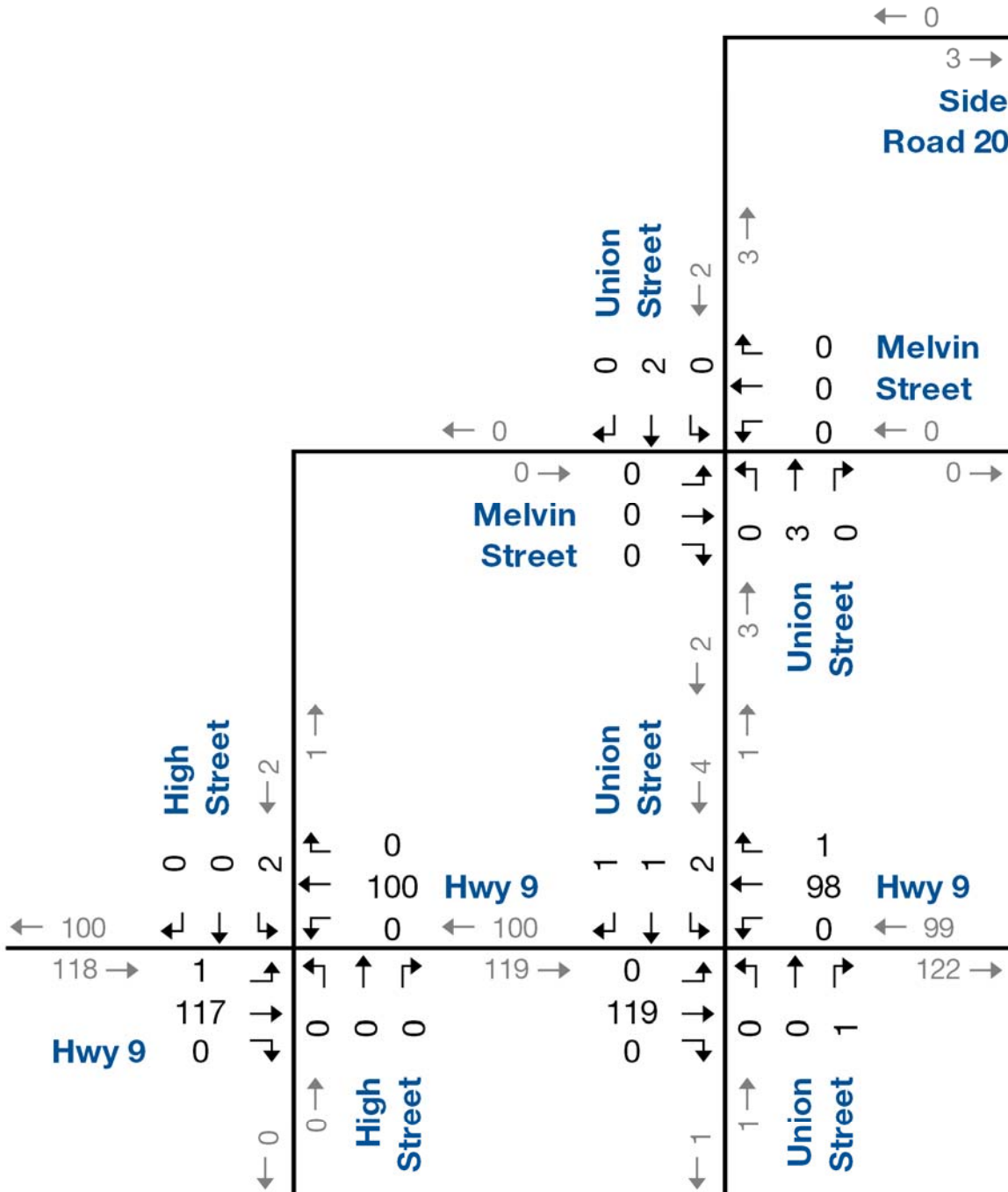
Pre-consultation with the Ministry of Transportation Ontario (MTO) was undertaken prior to commencing the TIS. A Terms of Reference (TOR) for the TIS was prepared and submitted to MTO, to identify issues and requirements that MTO would like to have addressed in the proposed TIS. The TOR was circulated to MTO on March 13, 2018, with additional study information provided on March 27, 2018.

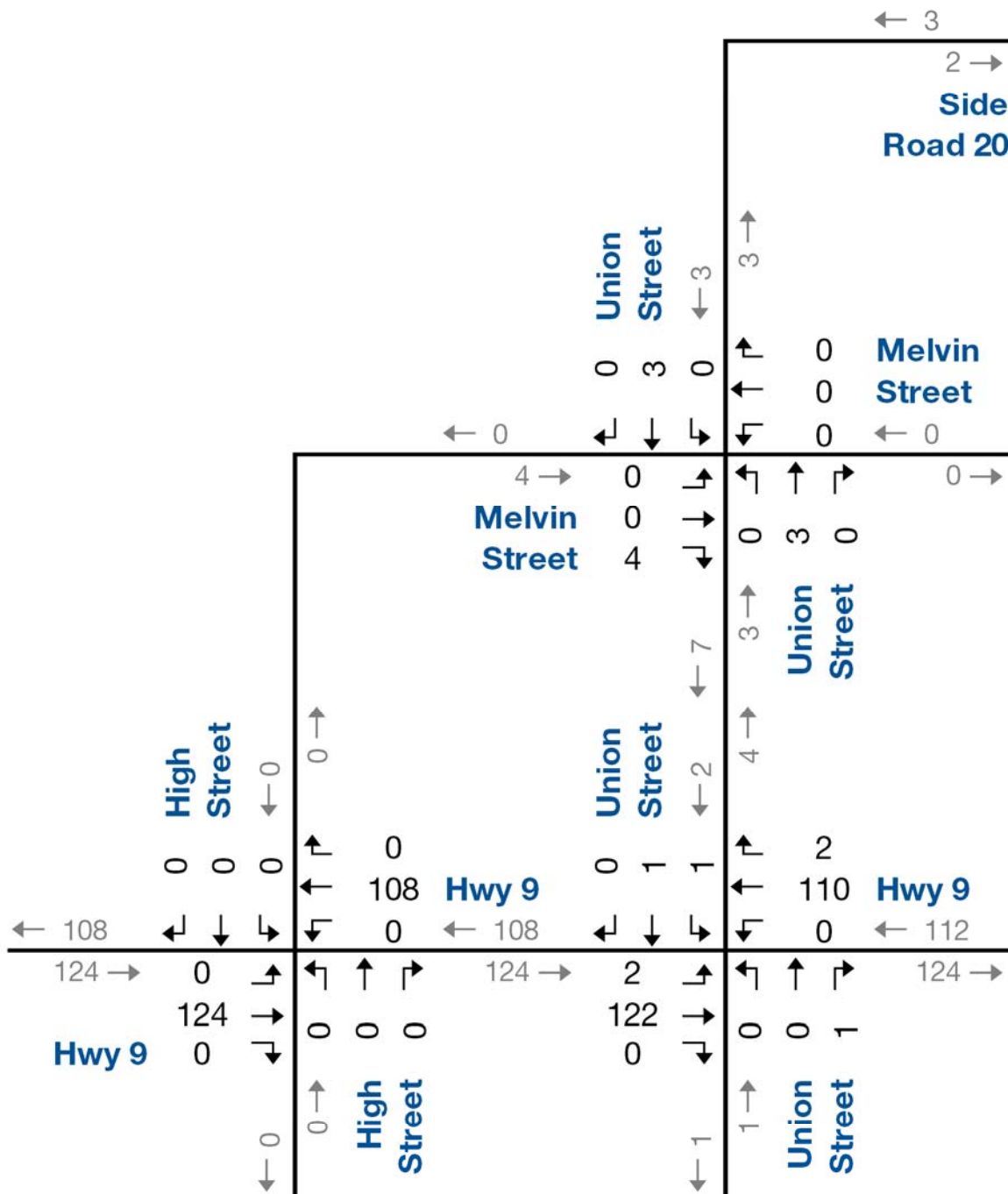
However, during a conference call between Paradigm and MTO on March 28, 2018, MTO indicated that the Ministry would not support a new intersection on Highway 9 based on the likely location of the new intersection in proximity to the Highway 9 and Teeswater River bridge and the distances from adjacent Highway 9 intersections (at Union Street and at Moscow Side Road). MTO confirmed this decision in writing on March 28, 2018. **Attachment B** provides the correspondence with MTO.

An MTO permit is required for new entrances on provincial highways. Introducing a new intersection on Highway 9 for a realigned Side Road 20 will require an MTO entrance permit. Ministry permits require conformance with the standards set out in MTO's Highway Access Management Guidelines¹. The guidelines classify Highway 9 as a 2B Arterial, which requires a desired intersection spacing of 1600 metres, and a minimum spacing of 800 metres. The proposed new intersection on Highway 9 in Riversdale would be located approximately 235 metres east of Union Street and 780 metres west of Moscow Side Road. Therefore, the location does not meet MTO's minimum spacing requirement.

¹ Ontario Ministry of Transportation. *Highway Access Management Guidelines*. December 2013.







NTS



PM Traffic Volumes

Summary and Conclusions

In summary, given the proximate location of the subject bridge and the study area to the Provincial Highway 9, we undertook pre-consultation with the Ministry of Transportation (MTO) prior to commencing the Transportation Impact Study (TIS). After reviewing the information that we provided, MTO has indicated that the Ministry will not permit a new intersection on Highway 9 for the potential realignment of Side Road 20, given its proximity to the Highway 9 bridge on the Teeswater River and the distances from existing Highway 9 intersections. The road realignment alternative envisaged for the proposed Class Environmental Assessment is, therefore, not a viable alternative.

It should also be noted that the proposed north-south realignment of Side Road 20 is closer to Teeswater River than Union Street and is likely to have significant environmental impacts. Similarly, extending Side Road 20 in the easterly direction to intersect Moscow Side Road as an alternative route to Highway 9, would potentially have major significant property impacts.

Additionally, the observed traffic volumes on Side Road 20 and on the subject bridge are significantly low to establish need and justification for new road alignments in the study area.

We trust this letter sufficiently outlines the infeasibility of extending Side Road 20 to Highway 9 on a new alignment. Extending Side Road 20 to Moscow Side Road is also not a feasible option. The low traffic volumes on Side Road 20 and the Riversdale Bridge are also not conducive to establishing need and justification for new road alignments in the study area and satisfy Municipal Class EA requirements.

If you have any questions or need clarifications, please contact Rajan Philips at (519) 896-3163 x207 or by email at rphilips@ptsl.com.

Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Jim Mallett
M.A.Sc., P.Eng., PTOE
President

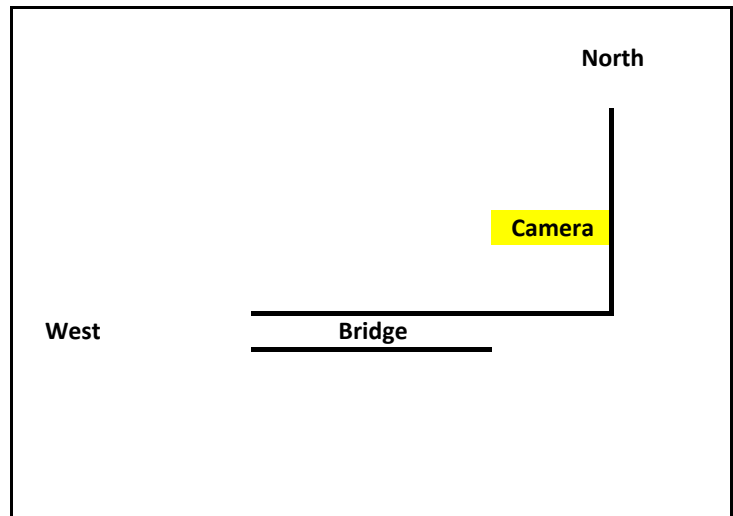


Attachment A

Turning Movement Counts



| | Westbound On the Bridge | Northbound Off the Bridge | |
|-------------|----------------------------|------------------------------|--------------------------|
| 6:00-6:15 | 0 | 0 | |
| 6:15-6:30 | 0 | 1 | |
| 6:30-6:45 | 0 | 1 | |
| 6:45-7:00 | 0 | 1 | |
| 7:00-7:15 | 0 | 0 | |
| 7:15-7:30 | 0 | 0 | |
| 7:30-7:45 | 0 | 0 | |
| 7:45-8:00 | 0 | 0 | |
| 8:00-8:15 | 0 | 0 | |
| 8:15-8:30 | 2 | 0 | |
| 8:30-8:45 | 0 | 0 | |
| 8:45-9:00 | 0 | 0 | |
| | | | |
| 11:00-11:15 | 1 | 0 | |
| 11:15-11:30 | 0 | 0 | |
| 11:00-11:45 | 0 | 1 | |
| 11:45-12:00 | 1 | 1 | |
| 12:00-12:15 | 1 | 1 | |
| 12:15-12:30 | 0 | 0 | Pedestrian walking a dog |
| 12:30-12:45 | 0 | 0 | Pedestrian walking a dog |
| 12:45-1:00 | 1 | 1 | |
| | | | |
| 3:00-3:15 | 0 | 2 | |
| 3:15-3:30 | 0 | 0 | |
| 3:30-3:45 | 0 | 2 | |
| 3:45-4:00 | 0 | 0 | |
| 4:00-4:15 | 1 | 0 | |
| 4:15-4:30 | 2 | 0 | |
| 4:30-4:45 | 0 | 0 | |
| 4:45-5:00 | 0 | 0 | |
| 5:00-5:15 | 2 | 0 | |
| 5:15-5:30 | 0 | 0 | |
| 5:30-5:45 | 0 | 0 | Pedestrian Walking a dog |
| 5:45-6:00 | 0 | 0 | |





Paradigm Transportation Solutions Limited
22 King Street South, Suite 300

Waterloo, Ontario, Canada N2J 1N8
519-896-3163 cbowness@ptsl.com

Count Name: Union Street Melvin Street
Site Code:
Start Date: 03/07/2018
Page No: 1

Turning Movement Data

| Start Time | Melvin Street Eastbound | | | | | | Driveway Westbound | | | | | | Union Street Northbound | | | | | | Union Street Southbound | | | | | | Int. Total |
|---------------|----------------------------|------|-------|--------|------|------------|-----------------------|------|-------|--------|------|------------|----------------------------|------|-------|--------|------|------------|----------------------------|------|-------|--------|------|------------|------------|
| | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | |
| 6:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 6:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 6:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 6:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| Hourly Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 1 | 0 | 0 | 0 | 1 | 4 |
| 7:00 AM | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 7:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 7:45 AM | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hourly Total | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 8:00 AM | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 8:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 8:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 8:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hourly Total | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 3 |
| *** BREAK *** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11:00 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 11:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11:45 AM | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| Hourly Total | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 3 | 0 | 2 | 0 | 0 | 0 | 2 | 6 |
| 12:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12:15 PM | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 4 |
| 12:30 PM | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 |
| 12:45 PM | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| Hourly Total | 1 | 0 | 2 | 0 | 1 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 0 | 1 | 3 | 7 |
| *** BREAK *** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3:00 PM | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 3:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 3:30 PM | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| 3:45 PM | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| Hourly Total | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 3 | 10 |
| 4:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| 4:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 2 |
| 4:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 4:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Hourly Total | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 3 | 5 |

| | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------|-------|-----|------|-----|-------|------|-----|-----|-----|-----|---|-----|-------|-------|-----|-------|-------|-------|-----|-------|-----|-----|-------|------|------|
| 5:00 PM | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 3 | |
| 5:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5:30 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| 5:45 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | |
| Hourly Total | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 0 | 2 | 3 | |
| Grand Total | 2 | 0 | 7 | 0 | 4 | 9 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 10 | 0 | 1 | 1 | 13 | 0 | 17 | 0 | 0 | 1 | 17 | 39 |
| Approach % | 22.2 | 0.0 | 77.8 | 0.0 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 15.4 | 76.9 | 0.0 | 7.7 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | - |
| Total % | 5.1 | 0.0 | 17.9 | 0.0 | - | 23.1 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 5.1 | 25.6 | 0.0 | 2.6 | - | 33.3 | 0.0 | 43.6 | 0.0 | 0.0 | - | 43.6 | - |
| Lights | 2 | 0 | 5 | 0 | - | 7 | 0 | 0 | 0 | 0 | - | 0 | 2 | 10 | 0 | 1 | - | 13 | 0 | 14 | 0 | 0 | - | 14 | 34 |
| % Lights | 100.0 | - | 71.4 | - | - | 77.8 | - | - | - | - | - | - | 100.0 | 100.0 | - | 100.0 | - | 100.0 | - | 82.4 | - | - | - | 82.4 | 87.2 |
| Mediums | 0 | 0 | 2 | 0 | - | 2 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 3 | 0 | 0 | - | 3 | 5 |
| % Mediums | 0.0 | - | 28.6 | - | - | 22.2 | - | - | - | - | - | - | 0.0 | 0.0 | - | 0.0 | - | 0.0 | - | 17.6 | - | - | - | 17.6 | 12.8 |
| Articulated Trucks | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Articulated Trucks | 0.0 | - | 0.0 | - | - | 0.0 | - | - | - | - | - | - | 0.0 | 0.0 | - | 0.0 | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Pedestrians | - | - | - | - | 4 | - | - | - | - | - | 0 | - | - | - | - | - | 1 | - | - | - | - | - | 1 | - | - |
| % Pedestrians | - | - | - | - | 100.0 | - | - | - | - | - | - | - | - | - | - | - | 100.0 | - | - | - | - | - | 100.0 | - | - |

Turning Movement Data Plot



Paradigm Transportation Solutions Limited
22 King Street South, Suite 300

Waterloo, Ontario, Canada N2J 1N8
519-896-3163 cbowness@ptsl.com

Count Name: Union Street Melvin Street
Site Code:
Start Date: 03/07/2018
Page No: 4

Turning Movement Peak Hour Data (6:15 AM)

| Start Time | Melvin Street Eastbound | | | | | | Driveway Westbound | | | | | | Union Street Northbound | | | | | | Union Street Southbound | | | | | | Int. Total |
|----------------------|-------------------------|-------|-------|--------|-------|------------|--------------------|-------|-------|--------|------|------------|-------------------------|-------|-------|--------|-------|------------|-------------------------|-------|-------|--------|------|------------|------------|
| | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | |
| 6:15 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 6:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 6:45 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 2 |
| 7:00 AM | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| Total | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 1 | 3 | 0 | 2 | 0 | 0 | 0 | 2 | 5 |
| Approach % | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | - |
| Total % | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 60.0 | 0.0 | 0.0 | - | 60.0 | 0.0 | 40.0 | 0.0 | 0.0 | - | 40.0 | - |
| PHF | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 | 0.750 | 0.000 | 0.000 | - | 0.750 | 0.000 | 0.500 | 0.000 | 0.000 | - | 0.500 | 0.625 |
| Lights | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 3 | 0 | 0 | - | 3 | 0 | 2 | 0 | 0 | - | 2 | 5 |
| % Lights | - | - | - | - | - | - | - | - | - | - | - | - | - | 100.0 | - | - | - | 100.0 | - | 100.0 | - | - | - | 100.0 | 100.0 |
| Mediums | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Mediums | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0 | - | - | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Articulated Trucks | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Articulated Trucks | - | - | - | - | - | - | - | - | - | - | - | - | - | 0.0 | - | - | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Pedestrians | - | - | - | - | 1 | - | - | - | - | - | 0 | - | - | - | - | - | 1 | - | - | - | - | - | 0 | - | - |
| % Pedestrians | - | - | - | - | 100.0 | - | - | - | - | - | - | - | - | - | - | - | 100.0 | - | - | - | - | - | - | - | - |

Turning Movement Peak Hour Data Plot (6:15 AM)

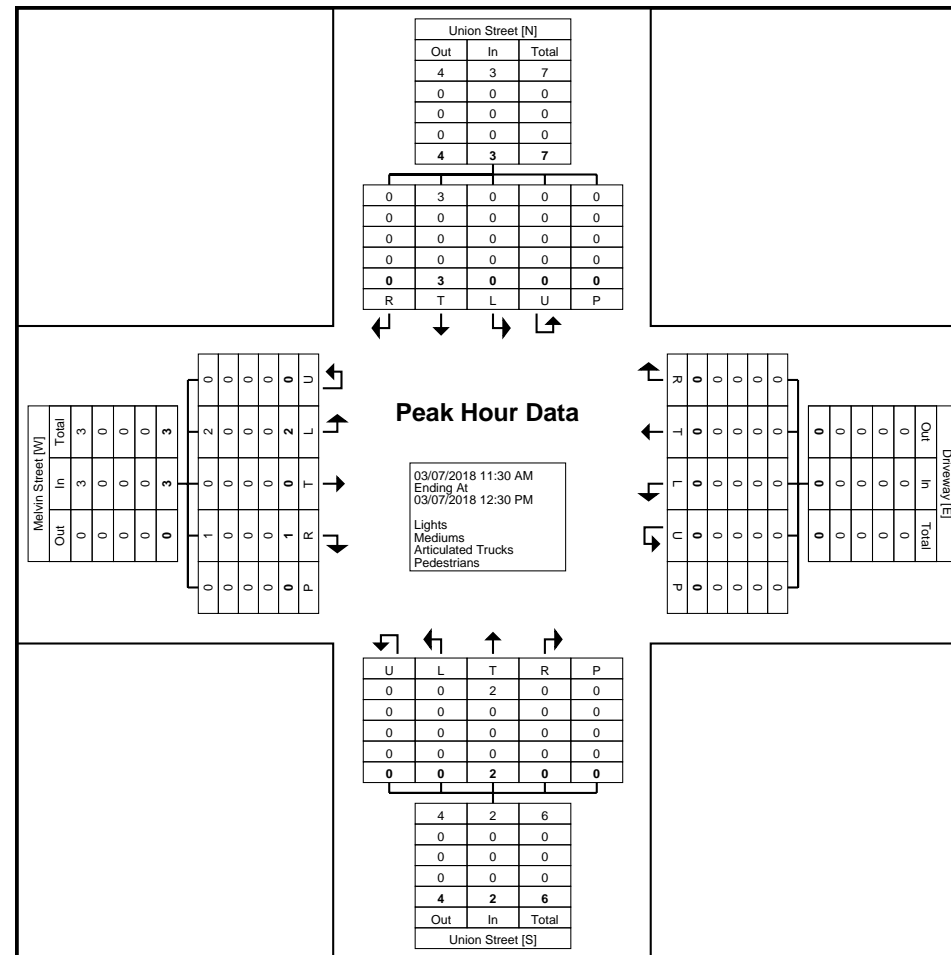
| Start Time | Melvin Street Eastbound | | | | | | Driveway Westbound | | | | | | Union Street Northbound | | | | | | Union Street Southbound | | | | | | Int. Total |
|----------------------|-------------------------|-------|-------|--------|------|------------|--------------------|-------|-------|--------|------|------------|-------------------------|-------|-------|--------|------|------------|-------------------------|-------|-------|--------|------|------------|------------|
| | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | |
| 11:30 AM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| 11:45 AM | 1 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| 12:00 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 12:15 PM | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 4 |
| Total | 2 | 0 | 1 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 3 | 0 | 0 | 0 | 3 | 8 |
| Approach % | 66.7 | 0.0 | 33.3 | 0.0 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | - |
| Total % | 25.0 | 0.0 | 12.5 | 0.0 | - | 37.5 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 25.0 | 0.0 | 0.0 | - | 25.0 | 0.0 | 37.5 | 0.0 | 0.0 | - | 37.5 | - |
| PHF | 0.500 | 0.000 | 0.250 | 0.000 | - | 0.375 | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 | 0.500 | 0.000 | 0.000 | - | 0.500 | 0.000 | 0.375 | 0.000 | 0.000 | - | 0.375 | 0.500 |
| Lights | 2 | 0 | 1 | 0 | - | 3 | 0 | 0 | 0 | 0 | - | 0 | 0 | 2 | 0 | 0 | - | 2 | 0 | 3 | 0 | 0 | - | 3 | 8 |
| % Lights | 100.0 | - | 100.0 | - | - | 100.0 | - | - | - | - | - | - | - | 100.0 | - | - | - | 100.0 | - | 100.0 | - | - | - | 100.0 | 100.0 |
| Mediums | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Mediums | 0.0 | - | 0.0 | - | - | 0.0 | - | - | - | - | - | - | - | 0.0 | - | - | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Articulated Trucks | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Articulated Trucks | 0.0 | - | 0.0 | - | - | 0.0 | - | - | - | - | - | - | - | 0.0 | - | - | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Pedestrians | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - |
| % Pedestrians | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |



Paradigm Transportation Solutions Limited
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Count Name: Union Street Melvin Street
Site Code:
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Turning Movement Peak Hour Data Plot (11:30 AM)

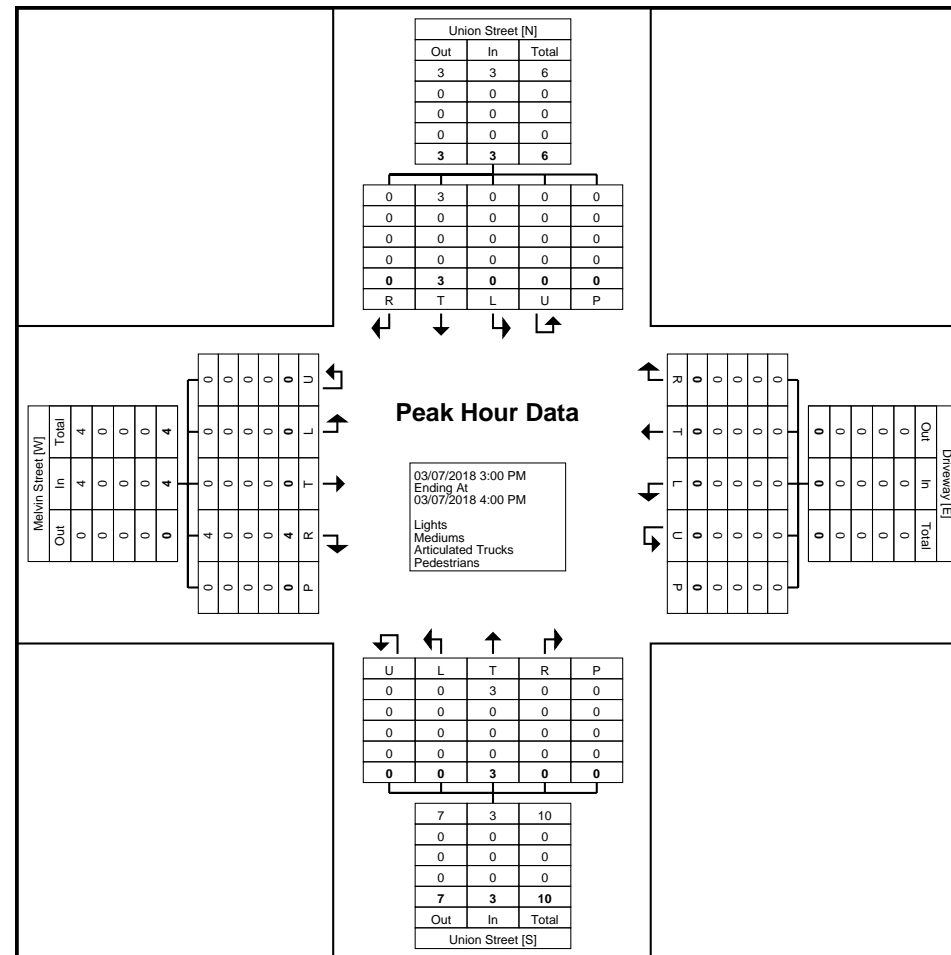
| Start Time | Melvin Street Eastbound | | | | | | Driveway Westbound | | | | | | Union Street Northbound | | | | | | Union Street Southbound | | | | | | Int. Total |
|----------------------|----------------------------|-------|-------|--------|------|------------|-----------------------|-------|-------|--------|------|------------|----------------------------|-------|-------|--------|------|------------|----------------------------|-------|-------|--------|------|------------|------------|
| | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | |
| 3:00 PM | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| 3:15 PM | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 |
| 3:30 PM | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| 3:45 PM | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 3 |
| Total | 0 | 0 | 4 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 3 | 0 | 3 | 0 | 0 | 0 | 3 | 10 |
| Approach % | 0.0 | 0.0 | 100.0 | 0.0 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | - |
| Total % | 0.0 | 0.0 | 40.0 | 0.0 | - | 40.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 0.0 | 30.0 | 0.0 | 0.0 | - | 30.0 | 0.0 | 30.0 | 0.0 | 0.0 | - | 30.0 | - |
| PHF | 0.000 | 0.000 | 0.500 | 0.000 | - | 0.500 | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.000 | 0.375 | 0.000 | 0.000 | - | 0.375 | 0.000 | 0.750 | 0.000 | 0.000 | - | 0.750 | 0.833 |
| Lights | 0 | 0 | 4 | 0 | - | 4 | 0 | 0 | 0 | 0 | - | 0 | 0 | 3 | 0 | 0 | - | 3 | 0 | 3 | 0 | 0 | - | 3 | 10 |
| % Lights | - | - | 100.0 | - | - | 100.0 | - | - | - | - | - | - | - | 100.0 | - | - | - | 100.0 | - | 100.0 | - | - | - | 100.0 | 100.0 |
| Mediums | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Mediums | - | - | 0.0 | - | - | 0.0 | - | - | - | - | - | - | - | 0.0 | - | - | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Articulated Trucks | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 0 |
| % Articulated Trucks | - | - | 0.0 | - | - | 0.0 | - | - | - | - | - | - | - | 0.0 | - | - | - | 0.0 | - | 0.0 | - | - | - | 0.0 | 0.0 |
| Pedestrians | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | 0 | - | - | - |
| % Pedestrians | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |



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Just before 9am a branch drops into the camera view. through out the day the view becomes more visible. Please process the data as best you can. The intersection volume is extremely low.



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Count Name: Highway 9 & High Street
Site Code:
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Page No: 1

Turning Movement Data

| Start Time | Highway 9 Eastbound | | | | | Highway 9 Westbound | | | | | High Street Southbound | | | | | Int. Total |
|---------------|------------------------|------|--------|------|------------|------------------------|-------|--------|------|------------|---------------------------|-------|--------|------|------------|------------|
| | Left | Thru | U-Turn | Peds | App. Total | Thru | Right | U-Turn | Peds | App. Total | Left | Right | U-Turn | Peds | App. Total | |
| 6:00 AM | 0 | 1 | 0 | 0 | 1 | 7 | 0 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 8 |
| 6:15 AM | 0 | 8 | 0 | 0 | 8 | 13 | 0 | 0 | 0 | 13 | 1 | 0 | 0 | 0 | 1 | 22 |
| 6:30 AM | 0 | 14 | 0 | 0 | 14 | 13 | 0 | 0 | 0 | 13 | 1 | 0 | 0 | 0 | 1 | 28 |
| 6:45 AM | 0 | 6 | 0 | 0 | 6 | 6 | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 12 |
| Hourly Total | 0 | 29 | 0 | 0 | 29 | 39 | 0 | 0 | 0 | 39 | 2 | 0 | 0 | 0 | 2 | 70 |
| 7:00 AM | 0 | 11 | 0 | 0 | 11 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 29 |
| 7:15 AM | 0 | 13 | 0 | 0 | 13 | 23 | 0 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 36 |
| 7:30 AM | 0 | 26 | 0 | 0 | 26 | 20 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 46 |
| 7:45 AM | 0 | 31 | 0 | 0 | 31 | 37 | 0 | 0 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 68 |
| Hourly Total | 0 | 81 | 0 | 0 | 81 | 98 | 0 | 0 | 0 | 98 | 0 | 0 | 0 | 0 | 0 | 179 |
| 8:00 AM | 1 | 31 | 0 | 0 | 32 | 24 | 0 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 56 |
| 8:15 AM | 0 | 27 | 0 | 0 | 27 | 17 | 0 | 0 | 0 | 17 | 1 | 0 | 0 | 0 | 1 | 45 |
| 8:30 AM | 0 | 28 | 0 | 0 | 28 | 22 | 0 | 0 | 0 | 22 | 1 | 0 | 0 | 0 | 1 | 51 |
| 8:45 AM | 0 | 21 | 0 | 0 | 21 | 13 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 34 |
| Hourly Total | 1 | 107 | 0 | 0 | 108 | 76 | 0 | 0 | 0 | 76 | 2 | 0 | 0 | 0 | 2 | 186 |
| *** BREAK *** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11:00 AM | 0 | 13 | 0 | 0 | 13 | 12 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 25 |
| 11:15 AM | 0 | 15 | 0 | 0 | 15 | 22 | 0 | 0 | 0 | 22 | 1 | 0 | 0 | 0 | 1 | 38 |
| 11:30 AM | 0 | 12 | 0 | 0 | 12 | 17 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 29 |
| 11:45 AM | 0 | 13 | 0 | 0 | 13 | 13 | 2 | 0 | 0 | 15 | 0 | 1 | 0 | 0 | 1 | 29 |
| Hourly Total | 0 | 53 | 0 | 0 | 53 | 64 | 2 | 0 | 0 | 66 | 1 | 1 | 0 | 0 | 2 | 121 |
| 12:00 PM | 0 | 16 | 0 | 0 | 16 | 17 | 0 | 0 | 0 | 17 | 0 | 1 | 0 | 0 | 1 | 34 |
| 12:15 PM | 0 | 13 | 0 | 0 | 13 | 18 | 0 | 0 | 0 | 18 | 1 | 0 | 0 | 0 | 1 | 32 |
| 12:30 PM | 0 | 12 | 0 | 0 | 12 | 11 | 0 | 0 | 1 | 11 | 0 | 0 | 0 | 0 | 0 | 23 |
| 12:45 PM | 0 | 16 | 0 | 0 | 16 | 13 | 0 | 0 | 0 | 13 | 0 | 0 | 1 | 0 | 1 | 30 |
| Hourly Total | 0 | 57 | 0 | 0 | 57 | 59 | 0 | 0 | 1 | 59 | 1 | 1 | 1 | 0 | 3 | 119 |
| *** BREAK *** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3:00 PM | 1 | 16 | 0 | 0 | 17 | 14 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 31 |
| 3:15 PM | 0 | 12 | 0 | 0 | 12 | 14 | 1 | 0 | 0 | 15 | 0 | 0 | 0 | 1 | 0 | 27 |
| 3:30 PM | 0 | 18 | 0 | 0 | 18 | 25 | 2 | 0 | 0 | 27 | 0 | 0 | 0 | 0 | 0 | 45 |
| 3:45 PM | 1 | 19 | 0 | 0 | 20 | 29 | 3 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 52 |
| Hourly Total | 2 | 65 | 0 | 0 | 67 | 82 | 6 | 0 | 0 | 88 | 0 | 0 | 0 | 1 | 0 | 155 |
| 4:00 PM | 0 | 28 | 0 | 0 | 28 | 19 | 0 | 0 | 0 | 19 | 0 | 1 | 0 | 0 | 1 | 48 |
| 4:15 PM | 1 | 18 | 0 | 0 | 19 | 34 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 0 | 0 | 53 |
| 4:30 PM | 0 | 23 | 0 | 0 | 23 | 28 | 0 | 0 | 0 | 28 | 0 | 0 | 0 | 0 | 0 | 51 |
| 4:45 PM | 0 | 38 | 0 | 0 | 38 | 26 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 64 |
| Hourly Total | 1 | 107 | 0 | 0 | 108 | 107 | 0 | 0 | 0 | 107 | 0 | 1 | 0 | 0 | 1 | 216 |
| 5:00 PM | 0 | 26 | 0 | 0 | 26 | 22 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 48 |

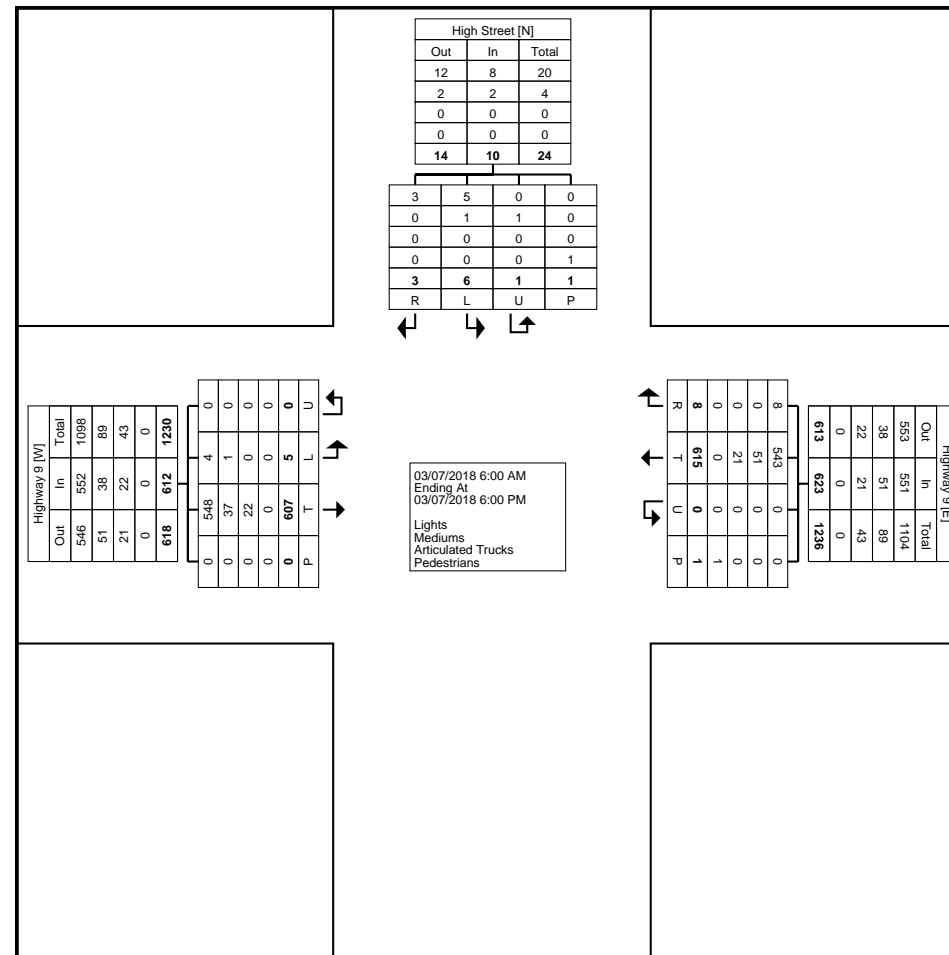
| | | | | | | | | | | | | | | | | |
|----------------------|------|------|-----|---|------|------|-------|-----|-------|------|------|-------|-------|-------|------|------|
| 5:15 PM | 0 | 37 | 0 | 0 | 37 | 32 | 0 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 69 |
| 5:30 PM | 1 | 23 | 0 | 0 | 24 | 19 | 0 | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 43 |
| 5:45 PM | 0 | 22 | 0 | 0 | 22 | 17 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 39 |
| Hourly Total | 1 | 108 | 0 | 0 | 109 | 90 | 0 | 0 | 0 | 90 | 0 | 0 | 0 | 0 | 0 | 199 |
| Grand Total | 5 | 607 | 0 | 0 | 612 | 615 | 8 | 0 | 1 | 623 | 6 | 3 | 1 | 1 | 10 | 1245 |
| Approach % | 0.8 | 99.2 | 0.0 | - | - | 98.7 | 1.3 | 0.0 | - | - | 60.0 | 30.0 | 10.0 | - | - | - |
| Total % | 0.4 | 48.8 | 0.0 | - | 49.2 | 49.4 | 0.6 | 0.0 | - | 50.0 | 0.5 | 0.2 | 0.1 | - | 0.8 | - |
| Lights | 4 | 548 | 0 | - | 552 | 543 | 8 | 0 | - | 551 | 5 | 3 | 0 | - | 8 | 1111 |
| % Lights | 80.0 | 90.3 | - | - | 90.2 | 88.3 | 100.0 | - | - | 88.4 | 83.3 | 100.0 | 0.0 | - | 80.0 | 89.2 |
| Mediums | 1 | 37 | 0 | - | 38 | 51 | 0 | 0 | - | 51 | 1 | 0 | 1 | - | 2 | 91 |
| % Mediums | 20.0 | 6.1 | - | - | 6.2 | 8.3 | 0.0 | - | - | 8.2 | 16.7 | 0.0 | 100.0 | - | 20.0 | 7.3 |
| Articulated Trucks | 0 | 22 | 0 | - | 22 | 21 | 0 | 0 | - | 21 | 0 | 0 | 0 | - | 0 | 43 |
| % Articulated Trucks | 0.0 | 3.6 | - | - | 3.6 | 3.4 | 0.0 | - | - | 3.4 | 0.0 | 0.0 | 0.0 | - | 0.0 | 3.5 |
| Pedestrians | - | - | - | 0 | - | - | - | - | 1 | - | - | - | - | 1 | - | - |
| % Pedestrians | - | - | - | - | - | - | - | - | 100.0 | - | - | - | - | 100.0 | - | - |



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Turning Movement Data Plot

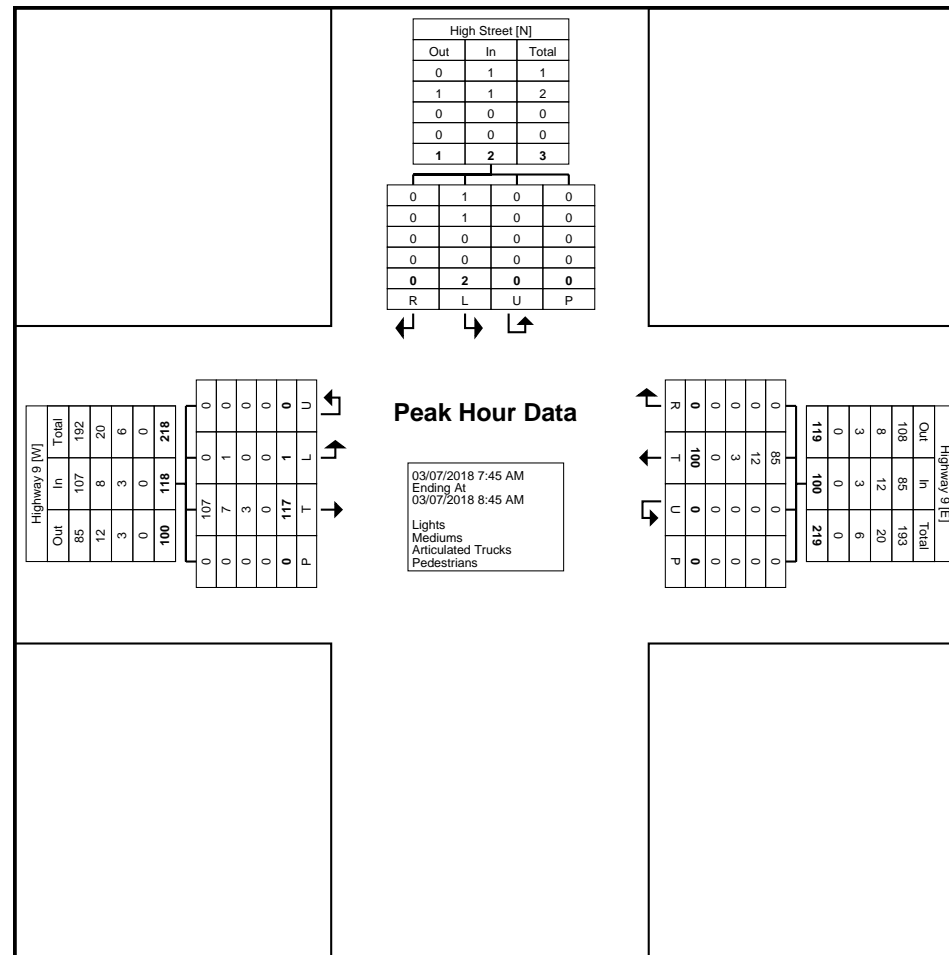
[illegible]



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Count Name: Highway 9 & High Street
Site Code:
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Turning Movement Peak Hour Data Plot (7:45 AM)

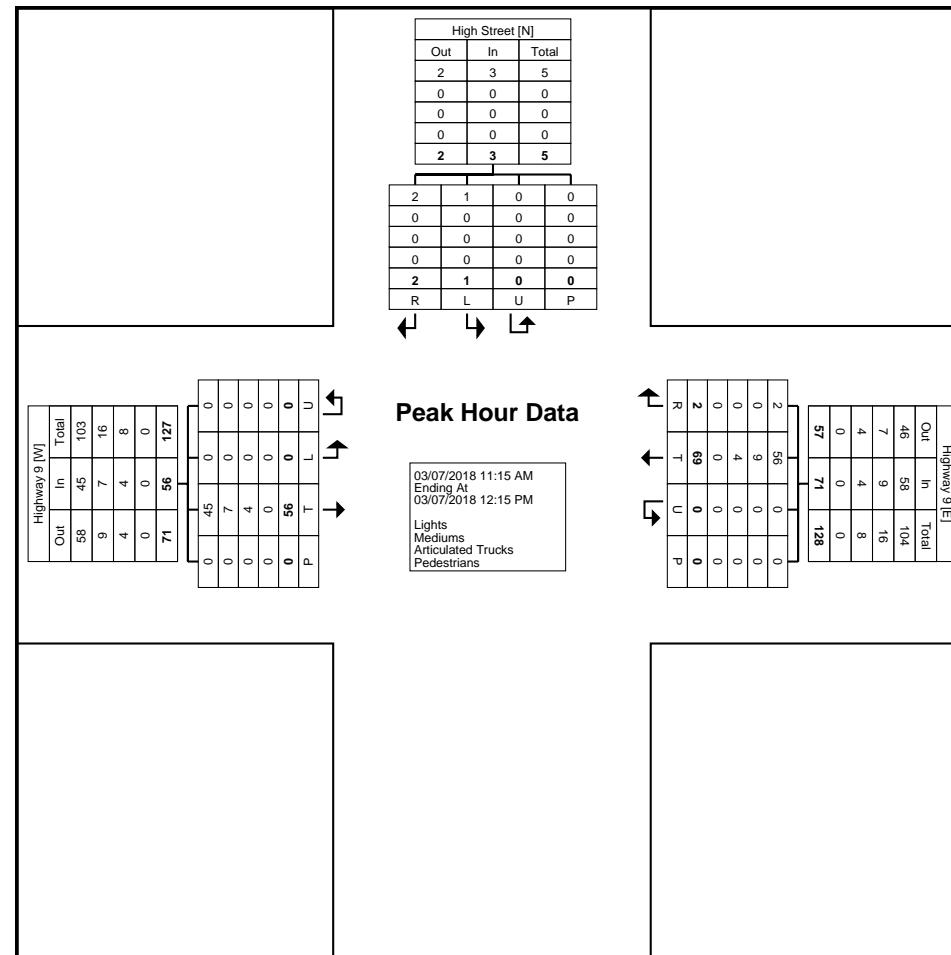
[illegible]



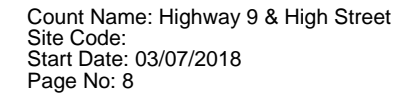
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Count Name: Highway 9 & High Street
Site Code:
Start Date: 03/07/2018
Page No: 7



Turning Movement Peak Hour Data Plot (11:15 AM)

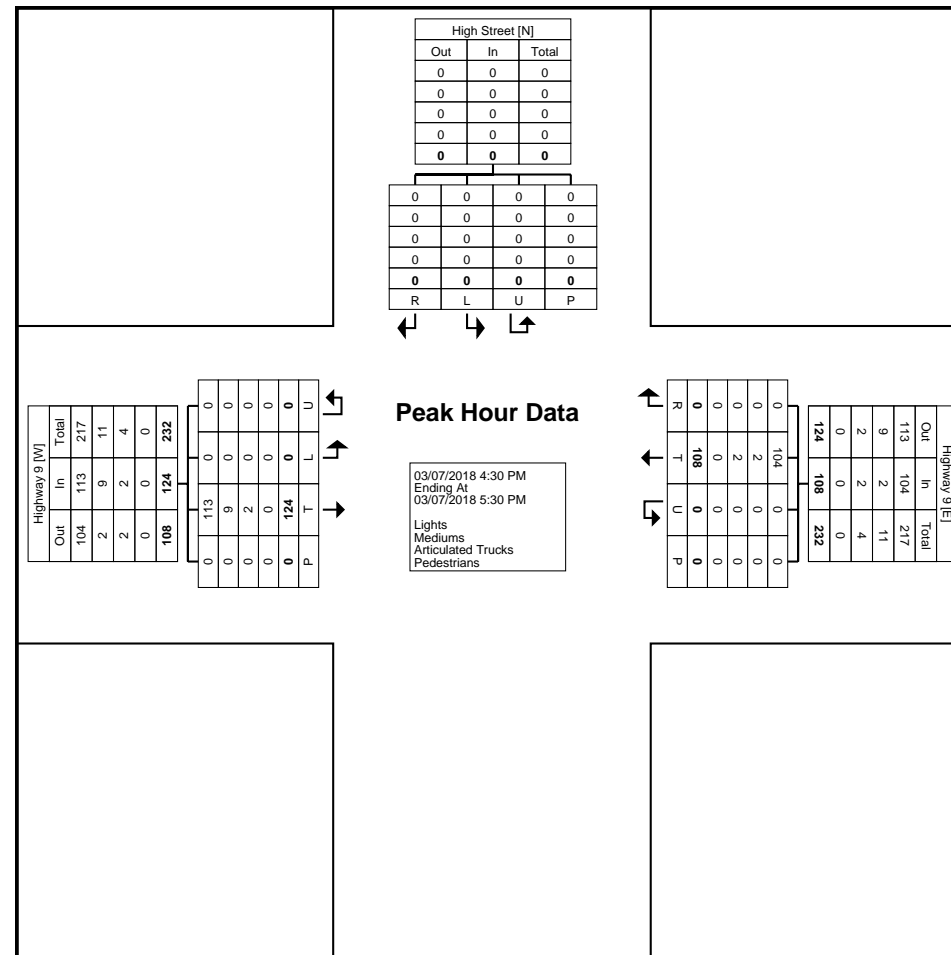
[illegible]



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Count Name: Highway 9 & High Street
Site Code:
Start Date: 03/07/2018
Page No: 9



Turning Movement Peak Hour Data Plot (4:30 PM)



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Count Name: Highway 9 & Union Street
Site Code:
Start Date: 03/07/2018
Page No: 1

Turning Movement Data

| Start Time | Highway 9 Eastbound | | | | | | Highway 9 Westbound | | | | | | Union Street Northbound | | | | | | Union Street Southbound | | | | | | Int. Total |
|---------------|------------------------|------|-------|--------|------|------------|------------------------|------|-------|--------|------|------------|----------------------------|------|-------|--------|------|------------|----------------------------|------|-------|--------|------|------------|------------|
| | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | |
| 6:00 AM | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 7 | 0 | 0 | 0 | 7 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 9 |
| 6:15 AM | 0 | 10 | 0 | 0 | 0 | 10 | 0 | 14 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 25 |
| 6:30 AM | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 13 | 0 | 0 | 0 | 13 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 28 |
| 6:45 AM | 0 | 7 | 0 | 0 | 0 | 7 | 0 | 6 | 1 | 0 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 15 |
| Hourly Total | 0 | 33 | 0 | 0 | 0 | 33 | 0 | 40 | 1 | 0 | 0 | 41 | 0 | 0 | 1 | 0 | 0 | 1 | 2 | 0 | 0 | 0 | 0 | 2 | 77 |
| 7:00 AM | 0 | 11 | 0 | 0 | 0 | 11 | 0 | 17 | 0 | 0 | 0 | 17 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 3 | 31 |
| 7:15 AM | 0 | 13 | 0 | 0 | 1 | 13 | 0 | 22 | 0 | 0 | 0 | 22 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 37 |
| 7:30 AM | 0 | 26 | 0 | 0 | 0 | 26 | 0 | 21 | 0 | 0 | 0 | 21 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 48 |
| 7:45 AM | 0 | 32 | 0 | 0 | 0 | 32 | 0 | 37 | 0 | 0 | 0 | 37 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 69 |
| Hourly Total | 0 | 82 | 0 | 0 | 1 | 82 | 0 | 97 | 0 | 0 | 0 | 97 | 0 | 0 | 1 | 0 | 0 | 1 | 3 | 0 | 2 | 0 | 1 | 5 | 185 |
| 8:00 AM | 0 | 31 | 0 | 0 | 0 | 31 | 0 | 24 | 0 | 0 | 0 | 24 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 57 |
| 8:15 AM | 0 | 28 | 0 | 0 | 0 | 28 | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 44 |
| 8:30 AM | 0 | 28 | 0 | 0 | 0 | 28 | 0 | 22 | 1 | 0 | 0 | 23 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 53 |
| 8:45 AM | 0 | 21 | 0 | 0 | 0 | 21 | 0 | 13 | 0 | 0 | 0 | 13 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 35 |
| Hourly Total | 0 | 108 | 0 | 0 | 0 | 108 | 0 | 74 | 1 | 0 | 0 | 75 | 0 | 0 | 2 | 0 | 0 | 2 | 2 | 1 | 1 | 0 | 0 | 4 | 189 |
| *** BREAK *** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 11:00 AM | 0 | 13 | 0 | 0 | 0 | 13 | 0 | 16 | 0 | 0 | 0 | 16 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 30 |
| 11:15 AM | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| 11:30 AM | 1 | 11 | 0 | 0 | 0 | 12 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 31 |
| 11:45 AM | 1 | 12 | 0 | 0 | 0 | 13 | 0 | 14 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 28 |
| Hourly Total | 2 | 51 | 0 | 0 | 0 | 53 | 0 | 66 | 0 | 0 | 0 | 66 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 3 | 122 |
| 12:00 PM | 0 | 16 | 0 | 0 | 0 | 16 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| 12:15 PM | 0 | 14 | 0 | 0 | 0 | 14 | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 2 | 0 | 0 | 3 | 32 |
| 12:30 PM | 1 | 11 | 0 | 0 | 0 | 12 | 0 | 11 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 23 |
| 12:45 PM | 0 | 16 | 0 | 0 | 0 | 16 | 0 | 12 | 0 | 0 | 0 | 12 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 29 |
| Hourly Total | 1 | 57 | 0 | 0 | 0 | 58 | 0 | 56 | 0 | 0 | 0 | 56 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 | 1 | 4 | 118 |
| *** BREAK *** | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 3:00 PM | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 14 | 1 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 30 |
| 3:15 PM | 0 | 11 | 0 | 0 | 0 | 11 | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 27 |
| 3:30 PM | 1 | 17 | 0 | 0 | 0 | 18 | 0 | 26 | 0 | 0 | 0 | 26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 45 |
| 3:45 PM | 0 | 19 | 0 | 0 | 0 | 19 | 0 | 31 | 0 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 52 |
| Hourly Total | 1 | 62 | 0 | 0 | 0 | 63 | 0 | 86 | 1 | 0 | 0 | 87 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 2 | 0 | 0 | 4 | 154 |
| 4:00 PM | 1 | 27 | 1 | 0 | 0 | 29 | 1 | 20 | 0 | 0 | 0 | 21 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 2 | 53 |
| 4:15 PM | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 31 | 1 | 0 | 0 | 32 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 52 |
| 4:30 PM | 0 | 23 | 0 | 0 | 0 | 23 | 0 | 30 | 1 | 0 | 0 | 31 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 55 |
| 4:45 PM | 0 | 37 | 0 | 0 | 0 | 37 | 0 | 23 | 0 | 0 | 0 | 23 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 61 |
| Hourly Total | 1 | 105 | 1 | 0 | 0 | 107 | 1 | 104 | 2 | 0 | 0 | 107 | 1 | 0 | 1 | 0 | 0 | 2 | 1 | 1 | 3 | 0 | 0 | 5 | 221 |

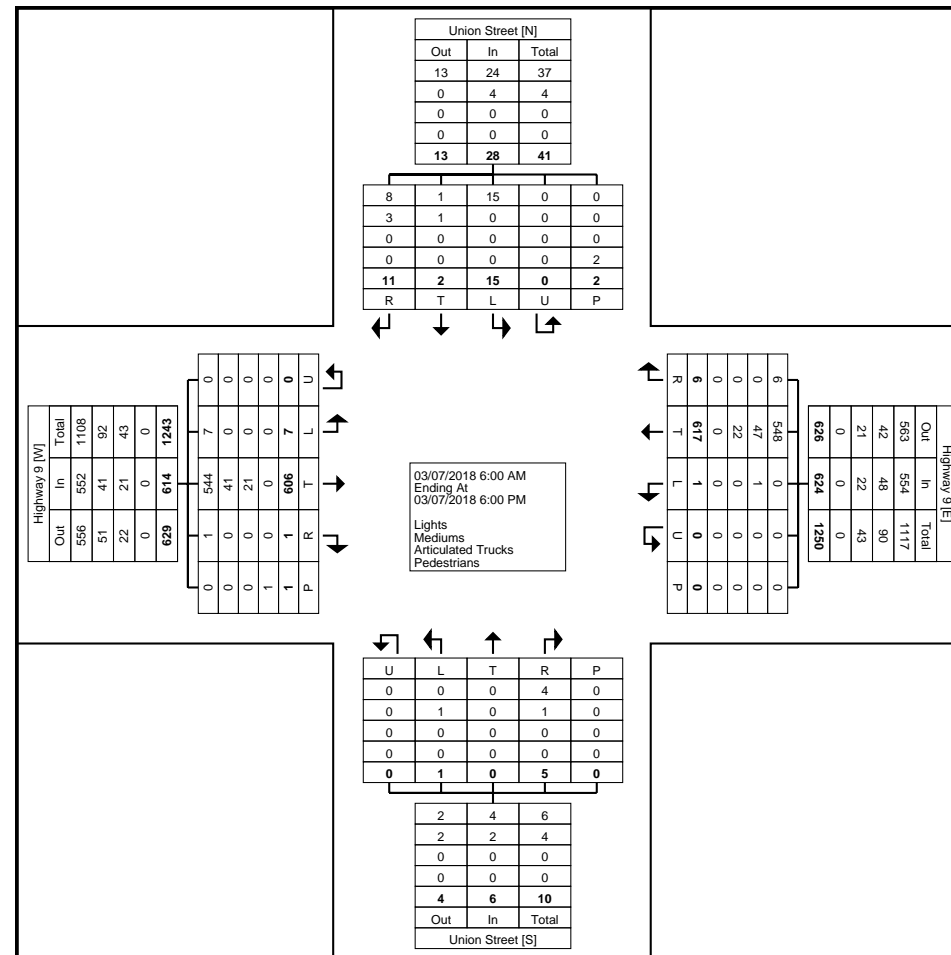
| | | | | | | | | | | | | | | | | | | | | | | | | | |
|----------------------|-------|------|-------|-----|-------|------|-------|------|-------|-----|---|------|-------|-----|------|-----|---|------|-------|------|------|-----|-------|------|------|
| 5:00 PM | 1 | 25 | 0 | 0 | 0 | 26 | 0 | 23 | 1 | 0 | 0 | 24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 50 | |
| 5:15 PM | 1 | 37 | 0 | 0 | 0 | 38 | 0 | 34 | 0 | 0 | 0 | 34 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 73 |
| 5:30 PM | 0 | 24 | 0 | 0 | 0 | 24 | 0 | 19 | 0 | 0 | 0 | 19 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 43 |
| 5:45 PM | 0 | 22 | 0 | 0 | 0 | 22 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 40 |
| Hourly Total | 2 | 108 | 0 | 0 | 0 | 110 | 0 | 94 | 1 | 0 | 0 | 95 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 206 |
| Grand Total | 7 | 606 | 1 | 0 | 1 | 614 | 1 | 617 | 6 | 0 | 0 | 624 | 1 | 0 | 5 | 0 | 0 | 6 | 15 | 2 | 11 | 0 | 2 | 28 | 1272 |
| Approach % | 1.1 | 98.7 | 0.2 | 0.0 | - | - | 0.2 | 98.9 | 1.0 | 0.0 | - | - | 16.7 | 0.0 | 83.3 | 0.0 | - | - | 53.6 | 7.1 | 39.3 | 0.0 | - | - | - |
| Total % | 0.6 | 47.6 | 0.1 | 0.0 | - | 48.3 | 0.1 | 48.5 | 0.5 | 0.0 | - | 49.1 | 0.1 | 0.0 | 0.4 | 0.0 | - | 0.5 | 1.2 | 0.2 | 0.9 | 0.0 | - | 2.2 | - |
| Lights | 7 | 544 | 1 | 0 | - | 552 | 0 | 548 | 6 | 0 | - | 554 | 0 | 0 | 4 | 0 | - | 4 | 15 | 1 | 8 | 0 | - | 24 | 1134 |
| % Lights | 100.0 | 89.8 | 100.0 | - | - | 89.9 | 0.0 | 88.8 | 100.0 | - | - | 88.8 | 0.0 | - | 80.0 | - | - | 66.7 | 100.0 | 50.0 | 72.7 | - | - | 85.7 | 89.2 |
| Mediums | 0 | 41 | 0 | 0 | - | 41 | 1 | 47 | 0 | 0 | - | 48 | 1 | 0 | 1 | 0 | - | 2 | 0 | 1 | 3 | 0 | - | 4 | 95 |
| % Mediums | 0.0 | 6.8 | 0.0 | - | - | 6.7 | 100.0 | 7.6 | 0.0 | - | - | 7.7 | 100.0 | - | 20.0 | - | - | 33.3 | 0.0 | 50.0 | 27.3 | - | - | 14.3 | 7.5 |
| Articulated Trucks | 0 | 21 | 0 | 0 | - | 21 | 0 | 22 | 0 | 0 | - | 22 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 43 |
| % Articulated Trucks | 0.0 | 3.5 | 0.0 | - | - | 3.4 | 0.0 | 3.6 | 0.0 | - | - | 3.5 | 0.0 | - | 0.0 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 0.0 | 3.4 |
| Pedestrians | - | - | - | - | 1 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 2 | - | - |
| % Pedestrians | - | - | - | - | 100.0 | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 100.0 | - | - |



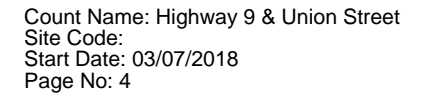
Paradigm Transportation Solutions Limited
22 King Street South, Suite 300

Waterloo, Ontario, Canada N2J 1N8
519-896-3163 cbowness@ptsl.com

Count Name: Highway 9 & Union Street
Site Code:
Start Date: 03/07/2018
Page No: 3



Turning Movement Data Plot

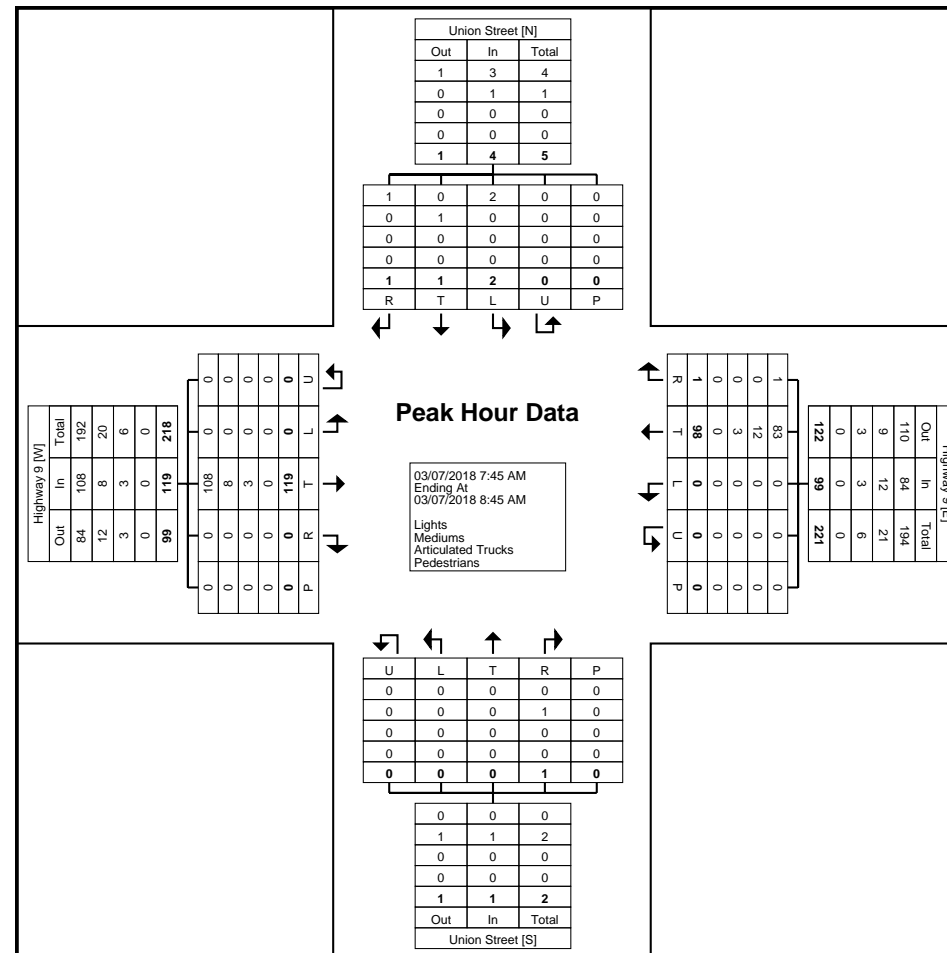




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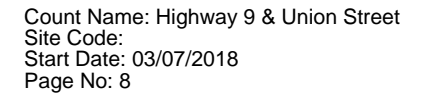
Count Name: Highway 9 & Union Street
Site Code:
Start Date: 03/07/2018
Page No: 5



Turning Movement Peak Hour Data Plot (7:45 AM)

| Start Time | Highway 9 Eastbound | | | | | | Highway 9 Westbound | | | | | | Union Street Northbound | | | | | | Union Street Southbound | | | | | | Int. Total |
|----------------------|------------------------|-------|-------|--------|------|------------|------------------------|-------|-------|--------|------|------------|----------------------------|-------|-------|--------|------|------------|----------------------------|-------|-------|--------|------|------------|------------|
| | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | Left | Thru | Right | U-Turn | Peds | App. Total | |
| 11:15 AM | 0 | 15 | 0 | 0 | 0 | 15 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 33 |
| 11:30 AM | 1 | 11 | 0 | 0 | 0 | 12 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 31 |
| 11:45 AM | 1 | 12 | 0 | 0 | 0 | 13 | 0 | 14 | 0 | 0 | 0 | 14 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 28 |
| 12:00 PM | 0 | 16 | 0 | 0 | 0 | 16 | 0 | 18 | 0 | 0 | 0 | 18 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 34 |
| Total | 2 | 54 | 0 | 0 | 0 | 56 | 0 | 68 | 0 | 0 | 0 | 68 | 0 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 126 |
| Approach % | 3.6 | 96.4 | 0.0 | 0.0 | - | - | 0.0 | 100.0 | 0.0 | 0.0 | - | - | 0.0 | 0.0 | 0.0 | 0.0 | - | - | 100.0 | 0.0 | 0.0 | 0.0 | - | - | - |
| Total % | 1.6 | 42.9 | 0.0 | 0.0 | - | 44.4 | 0.0 | 54.0 | 0.0 | 0.0 | - | 54.0 | 0.0 | 0.0 | 0.0 | 0.0 | - | 0.0 | 1.6 | 0.0 | 0.0 | 0.0 | - | 1.6 | - |
| PHF | 0.500 | 0.844 | 0.000 | 0.000 | - | 0.875 | 0.000 | 0.944 | 0.000 | 0.000 | - | 0.944 | 0.000 | 0.000 | 0.000 | 0.000 | - | 0.000 | 0.500 | 0.000 | 0.000 | 0.000 | - | 0.500 | 0.926 |
| Lights | 2 | 44 | 0 | 0 | - | 46 | 0 | 56 | 0 | 0 | - | 56 | 0 | 0 | 0 | 0 | - | 0 | 2 | 0 | 0 | 0 | - | 2 | 104 |
| % Lights | 100.0 | 81.5 | - | - | - | 82.1 | - | 82.4 | - | - | - | 82.4 | - | - | - | - | - | - | 100.0 | - | - | - | - | 100.0 | 82.5 |
| Mediums | 0 | 6 | 0 | 0 | - | 6 | 0 | 8 | 0 | 0 | - | 8 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 14 |
| % Mediums | 0.0 | 11.1 | - | - | - | 10.7 | - | 11.8 | - | - | - | 11.8 | - | - | - | - | - | - | 0.0 | - | - | - | - | 0.0 | 11.1 |
| Articulated Trucks | 0 | 4 | 0 | 0 | - | 4 | 0 | 4 | 0 | 0 | - | 4 | 0 | 0 | 0 | 0 | - | 0 | 0 | 0 | 0 | 0 | - | 0 | 8 |
| % Articulated Trucks | 0.0 | 7.4 | - | - | - | 7.1 | - | 5.9 | - | - | - | 5.9 | - | - | - | - | - | - | 0.0 | - | - | - | - | 0.0 | 6.3 |
| Pedestrians | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - | - | - | - | 0 | - | - |
| % Pedestrians | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |

Turning Movement Peak Hour Data Plot (11:15 AM)



Turning Movement Peak Hour Data Plot (4:30 PM)

Attachment B

Correspondence with MTO



07 March 2018
Project: 180043

Zsolt Katzirz
Corridor Management Planner (A)
Ministry of Transportation of Ontario
659 Exeter Road
London, ON N6E 1L3

Dear Mr. Dixon:

**RE: RIVERSDALE BRIDGE NO. 2 EA STUDY – TOR FOR TRANSPORTATION IMPACT STUDY
BROCKTON, BRUCE COUNTY**

Paradigm Transportation Solutions Limited (Paradigm) has been retained by the Municipality of Brockton (the Client) to carry out a Transportation Impact Study to provide background information prior to the Municipal Class Environmental Assessment (EA) that the Municipality is undertaking to address an aging heritage bridge in Riversdale, located on Side Road 20, to the north of Highway 9. The Municipality has retained GM BluePlan Engineering Limited (GMBP) to carry out the EA Study.

The purpose of the Terms of Reference (TOR) is to identify issues and requirements that the Ministry of Transportation Ontario (MTO), the Municipality of Brockton, and the County of Bruce would like to have addressed in the proposed Transportation Impact Study (TIS). The TIS is being undertaken prior to initiating the EA process to determine the technical feasibility of some of the potential alternatives that may be considered in the EA.

Project Background

The Riversdale community is located west of Walkerton, at the crossing of Highway 9 and the Teeswater River. The Riversdale Bridge (aka. Greenock Bridge No.0002) is an aging steel pony truss bridge located on Side Road 20, to the north of Highway 9, within Lot 30, Concession 1N in the former Township of Greenock, Municipality of Brockton. The subject bridge is part of Side Road 20 West and crosses the Teeswater River immediately to the northeast of the Village of Riversdale. The TIS will address the following potential alternatives:

- ▶ **Road Realignment:** Close Bridge No. 0002 to vehicular traffic (i.e. removal or adaptive re-use) with road realignment of Side Road 20 directly south to a new intersection Highway 9; and
- ▶ **Maintain Bridge Crossing:** Reconstruct or re-habilitate Bridge No. 0002 and maintain the existing road alignment across the Teeswater River.

The above-noted alternatives will require Ministry of Transportation Ontario (MTO) review including an assessment of the traffic impacts and feasibility of a new intersection on Highway 9. The TIS will

assess the technical feasibility of closing Bridge No.0002 (Riversdale) to vehicular traffic and re-routing the road parallel to the river to a new intersection with Highway 9. In particular, this study will assess the traffic impacts and feasibility of providing a new intersection on Highway 9, east of the existing Highway 9 Bridge on the Teeswater River.

TIS Work Plan

The following outlines our work plan for the TIS.

- ▶ **Task 1 – Start-up Consultation:** We will co-ordinate through the Municipality and GM BluePlan to identify concerns and requirements of the MTO and municipalities pertaining to the TIS and the identification of alternatives. Specifically, we will use start-up consultation to obtain available background information, including traffic data, collision history and information on potential new developments in the study area that could add to future traffic volumes. We will also confirm with MTO the background traffic growth rate for Highway 9. The growth rates will be based on historic growth rates including those on Highway 9.
- ▶ **Task 2 – Traffic Data Collection:** The collection of existing roadway and intersection traffic data will be critical to this assignment - for reviewing existing traffic patterns and developing future traffic distribution associated with potential bridge closure and a new connection to Highway 9. We will obtain all available roadway traffic and intersection turning movement data for Highway 9 from MTO.

In addition, we will obtain intersection turning movement counts at the following intersections:

- Highway 9 at Union Street (two-way Stop-controlled);
- Highway 9 at High Street (two-way Stop-controlled);
- Union Street at Melvin Street (two-way Stop-controlled); and
- Side Road 20 on the subject bridge.

The traffic data at the various intersections will be collected simultaneously to develop a reasonably accurate picture of existing traffic patterns on Highway 9 and the local Riversdale roads including the subject bridge. Along with data gathering we will also carry out a site investigation of the study area roads to observe traffic flows, existing traffic controls, and potential sightline issues at the new intersection location.

- ▶ **Task 3 – Traffic Review and Analysis:** The main purpose of the traffic control component of the TIS is to assess the traffic impacts and feasibility of providing a new intersection on Highway 9 east of the existing Highway 9 bridge on the Teeswater River. Our review and analysis will include the following:
 - Review existing traffic data and develop existing traffic flows on Highway 9 and the local road system including intersections and the subject bridge. Undertake operational analysis for the two intersections on Highway 9 and the interior intersection at Melvin Street and Union Street.
 - Carryout the distribution of traffic volumes assuming the closure of the subject bridge. This would involve the extension of Side Road 20 to Highway 9 and the assignment of traffic volumes and including turning movements at the new intersection. There will be a corresponding reduction in traffic and turning movement at the two existing intersections on Highway 9. Undertake operational analysis of the existing and new intersections.



- Repeat the above steps under future traffic conditions corresponding to the two alternatives. The horizon year will be the same as used in the EA study. Future traffic conditions will be developed based on roadway background traffic growth and any new development traffic from potential new developments identified.
 - Collision data will be reviewed for assessments as appropriate.
 - Where required, signal warrant analysis will be carried out in accordance with the OTM Book 12 traffic control signal warrant requirements.
- **Task 4 – Memorandum:** Based on the results of Task 3, we will prepare a Technical Memorandum summarizing the background information, data, the results of the analysis and recommendations, identifying:
- Traffic impacts associated with the two alternatives;
 - The feasibility of providing a new intersection on Highway 9; and
 - The intersection geometry and traffic controls for the new intersection and potential modifications to the existing intersections on Highway 9.

We would appreciate receiving your feedback on the proposed Terms of Reference. If you have any questions or need clarifications, please contact Rajan Philips at (519) 896-3163 x207 or by email at rphilips@ptsl.com.

Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Jim Mallett

M.A.Sc., P.Eng., PTOE
President

Copy

John Strader, Municipality of Brockton
John Slocombe, GM BluePlan



Heather Goodman

From: Katzirz, Zsolt (MTO) <Zsolt.Katzirz@ontario.ca>
Sent: March 28, 2018 9:59 AM
To: Heather Goodman
Cc: Drea Nelson - GM BluePlan; Rajan Philips; John Slocombe - GM BluePlan
Subject: MTO Comments - Hwy 9 - Riversdale Bridge - TIS & TOR
Attachments: 212326 Riversdale Bridge (Zoning).pdf; 180043 (Riversdale Bridge EA) - Study Area.pdf

Hi Heather,

Per discussion we have several concerns with the proposed "new intersection" including the following (and not limited to):

- Proximity of intersection to structure on Highway 9.
- Intersection spacing. MTO minimum intersection spacing for a new intersection (or commercial entrance) is 1600m desire (800m minimum).

For the above noted reasons we are not supportive of the proposed new intersection. Please note that we need to understand (and accept) the concept in general prior to requiring supporting reports, there are significant limitations to reports such as a traffic impact study.

Please feel free to contact me for further discussion.

Regards,

Zsolt Katzirz | Highway Corridor Management Planner
Highway Corridor Management | West Region | Engineering Office
Provincial Highways Management | Ministry of Transportation
1st Floor | 659 Exeter Road | London, ON, N6E 1L3
Telephone: 519-873-4598 | Toll Free: 1-800-265-6072 Ext. 4598
Fax: (519) 873-4228 | E-mail: zsolt.katzirz@ontario.ca

Please consider the environment before printing this email



Public Website: <http://www.mto.gov.on.ca/english/engineering/management/corridor/index.shtml>

From: Heather Goodman [mailto:hgoodman@ptsl.com]
Sent: March-27-18 3:48 PM
To: Katzirz, Zsolt (MTO)
Cc: Drea Nelson - GM BluePlan; Rajan Philips; John Slocombe - GM BluePlan
Subject: RE: 180043 (Riversdale Bridge) - Terms of Reference

Hi Zsolt,

I want to clarify that this is not a typical TIS where a development is being contemplated. The purpose of this analysis is to determine if the extension of Side Road 20 to a new intersection connection on Highway 9 is feasible from a transportation perspective, including sight lines, intersection spacing, traffic control, auxiliary lanes, etc. We want to ensure the study conforms to MTO's requirements, specifically the growth rate for the area. That way, if this alternative is selected for further analysis, the traffic study conforms to MTO requirements.

I can provide the following information regarding the intersection based on the site visit and analysis completed thus far. Attached is a figure of the study area:

- The proposed intersection would be located east of the Teeswater River, on the north side of Highway 9 as a direct southward extension of Side Road 20. There is an existing road allowance for this extension. The road allowance may have to be moved to the east to avoid the floodplains. (See attached parcel map).
- The proposed Side Road 20 extension would be a two-lane roadway.
- The proposed intersection would be a T-intersection, with stop-control on Side Road 20 and free flow on Highway 9. No auxiliary lanes would be required.
- This is approximately 235 metres east of Union Street and 780 metres west Moscow Side Road. There is a private driveway approximately 240 metres east of the proposed intersection. The location of the proposed intersection meets TAC minimum spacing requirements
- Sight distance of over 350 metres is provided in each direction. This exceeds TAC recommendations.
- The speed limit on Highway 9 at this location is 80 km/h east of the Teeswater River bridge and 70 km/h to the west.

Please let me know if you have any questions.

Thanks,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant



Paradigm Transportation Solutions Limited

p: 416.479.9684 x502
m: 905.506.0454

From: Katzirz, Zsolt (MTO) [<mailto:Zsolt.Katzirz@ontario.ca>]
Sent: March 21, 2018 9:32 AM
To: Heather Goodman <hgoodman@ptsl.com>
Subject: RE: 180043 (Riversdale Bridge) - Terms of Reference

Hi Heather,

Prior to agreeing to a traffic impact study we need to see conceptual plans of what is being proposed.

If an intersection is being re-aligned (along the provincial highway) we need to review items such as (but not limit to) intersection spacing and site lines to determine if we agree in principle prior to asking for supporting data such as a traffic impact study.

Regards,

Zsolt Katzirz | Highway Corridor Management Planner
Highway Corridor Management | West Region | Engineering Office
Provincial Highways Management | Ministry of Transportation
1st Floor | 659 Exeter Road | London, ON, N6E 1L3
Telephone: 519-873-4598 | Toll Free: 1-800-265-6072 Ext. 4598
Fax: (519) 873-4228 | E-mail: zsolt.katzirz@ontario.ca

Please consider the environment before printing this email



From: Heather Goodman [<mailto:hgoodman@ptsl.com>]

Sent: March-13-18 11:42 AM

To: Katzirz, Zsolt (MTO)

Cc: Rajan Philips; Drea Nelson - GM BluePlan; John Slocombe - GM BluePlan; Brent Willis - GM BluePlan; jstrader@brockton.ca

Subject: 180043 (Riversdale Bridge) - Terms of Reference

Hi Zsolt,

Further to our phone discussion last week, Paradigm has been retained by the Municipality of Brockton to carry out a Transportation Impact Study to provide background information prior to the Municipal Class Environmental Assessment (EA) that the Municipality is undertaking to address an aging heritage bridge in Riversdale, located on Side Road 20, to the north of Highway 9, detailed in the enclosed project overview and work plan. The TIS is being undertaken prior to initiating the EA process to determine the technical feasibility of some of the potential alternatives that may be considered in the EA.

We ask that you please review the work plan to ensure the scope of the study is acceptable and provide comments if necessary.

In addition, we request the following information from MTO for our study:

- ▶ The following intersections will be included in the study, please confirm this is acceptable.
 - Highway 9 at Union Street (two-way Stop-controlled);
 - Highway 9 at High Street (two-way Stop-controlled);
 - Union Street at Melvin Street (two-way Stop-controlled); and
 - Side Road 20 on the subject bridge.
- ▶ The traffic impact study will be prepared to conform to MTO guidelines and will assess a 20-year horizon. Please confirm this is acceptable.
- ▶ Please provide the growth rate to be used for the study.

Due to the time sensitive nature of the project, we ask that you please provide comments at your earliest convenience. Please do not hesitate to contact me if you have questions relating to this project.

Regards,

Heather Goodman, B.Eng., EIT, MITE

Transportation Consultant



Paradigm Transportation Solutions Limited

5000 Yonge Street, Suite 1901, Toronto ON M2N 7E9

p: 416.479.9684 x502

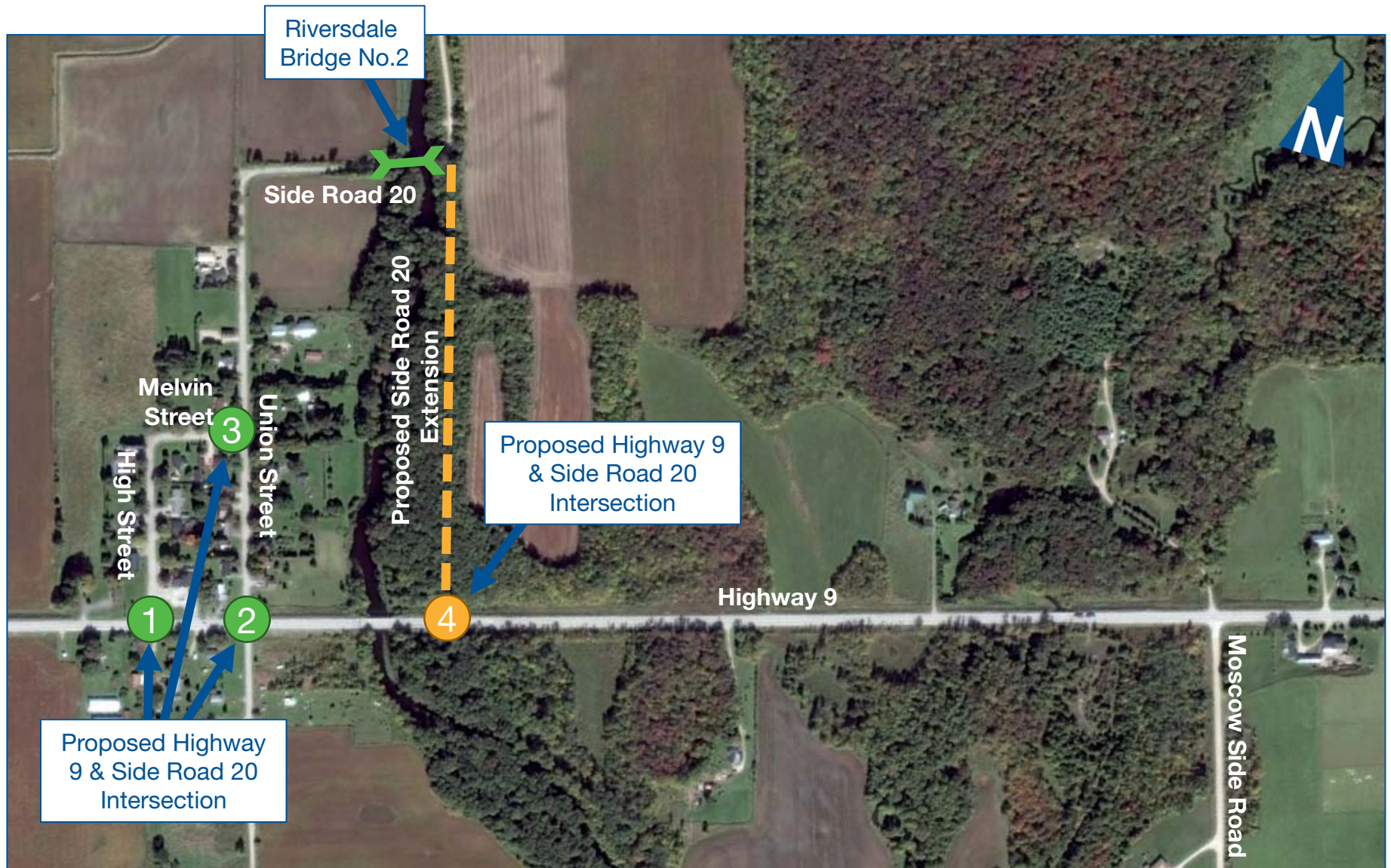
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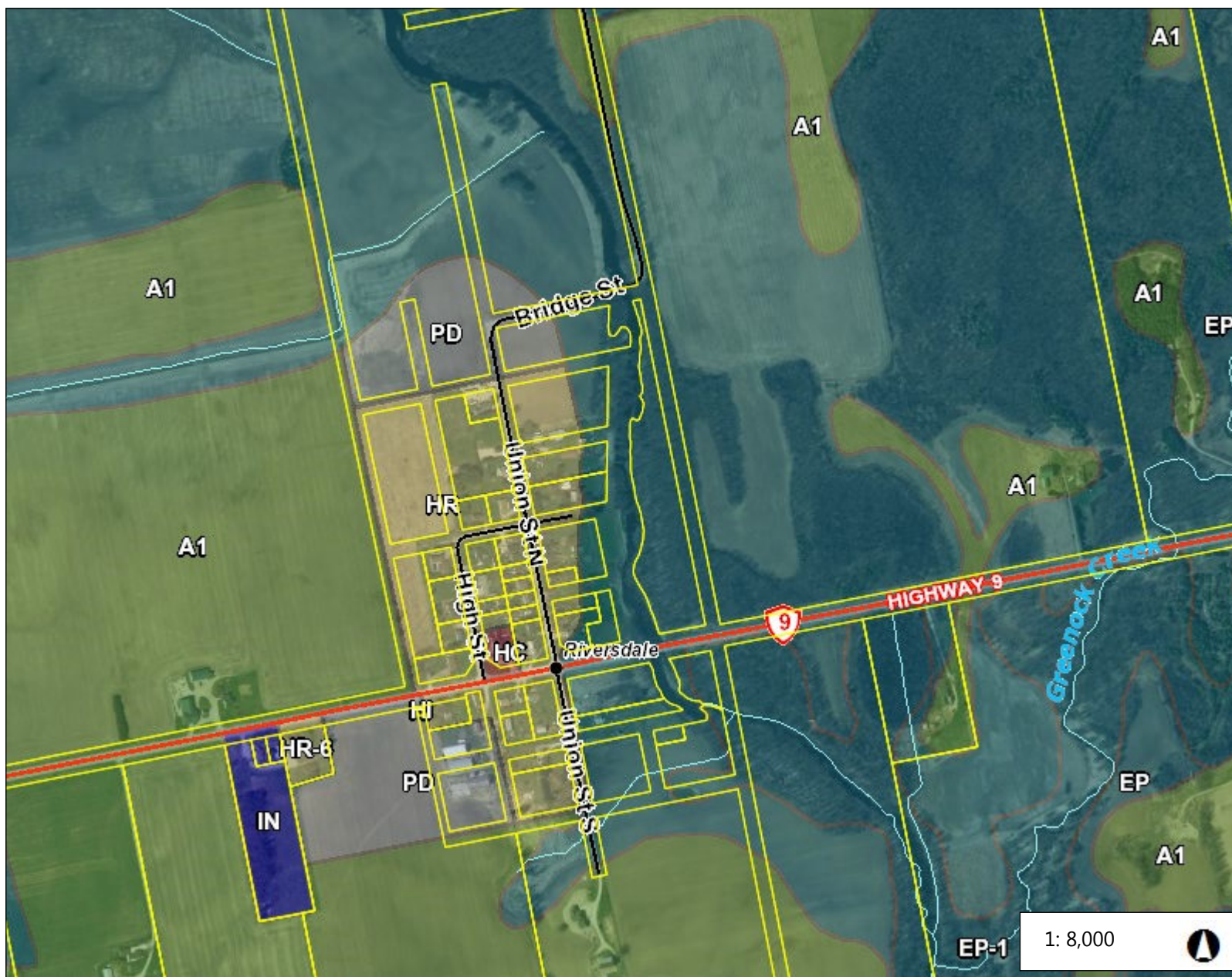
w: www.ptsl.com

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Study Area



Legend

- Ferry
- Provincial Highway
- County Road
- Municipal or Other Road
- Watercourse

- Permanent Stream
- Intermittent Stream

Zones (semi-transparent)

- Environmental Protection/Hazard
- Environmental Protection/Hazard H
- Wetland
- General Agriculture/Rural
- General Agriculture/Rural Holding
- Restricted Agriculture/Rural
- Restricted Agriculture/Rural Holding
- Hamlet Residential
- Mobile Home Park Residential
- Inland Lake Residential
- Lakeshore Residential
- Lakeshore Residential Holding
- Lifestyle Community Residential
- Lifestyle Community Residential Hc
- Resort/Cottage Residential
- Resort Residential Holding
- Office Residential
- Detached Residential

Notes

0.4 0 0.20 0.4 Kilometers

NAD_1983_UTM_Zone_17N
© 2017 County of Bruce

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

07 March 2018
Project: 180043

Zsolt Katzirz
Corridor Management Planner (A)
Ministry of Transportation of Ontario
659 Exeter Road
London, ON N6E 1L3

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BROCKTON, BRUCE COUNTY**

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We would appreciate receiving your feedback on the proposed Terms of Reference. If you have any questions or need clarifications, please contact Rajan Philips at (519) 896-3163 x207 or by email at rphilips@ptsl.com.

Yours very truly,

PARADIGM TRANSPORTATION SOLUTIONS LIMITED



Jim Mallett
M.A.Sc., P.Eng., PTOE
President

Copy
John Strader, Municipality of Brockton
John Slocombe, GM BluePlan



Drea Nelson - GM BluePlan

From: Katzirz, Zsolt (MTO) <Zsolt.Katzirz@ontario.ca>
Sent: Wednesday, March 28, 2018 9:59 AM
To: Heather Goodman
Cc: Drea Nelson - GM BluePlan; Rajan Philips; John Slocombe - GM BluePlan
Subject: MTO Comments - Hwy 9 - Riversdale Bridge - TIS & TOR
Attachments: 212326 Riversdale Bridge (Zoning).pdf; 180043 (Riversdale Bridge EA) - Study Area.pdf

Hi Heather,

Per discussion we have several concerns with the proposed "new intersection" including the following (and not limited to):

- Proximity of intersection to structure on Highway 9.
- Intersection spacing. MTO minimum intersection spacing for a new intersection (or commercial entrance) is 1600m desire (800m minimum).

For the above noted reasons we are not supportive of the proposed new intersection. Please note that we need to understand (and accept) the concept in general prior to requiring supporting reports, there are significant limitations to reports such as a traffic impact study.

Please feel free to contact me for further discussion.

Regards,

Zsolt Katzirz | Highway Corridor Management Planner
Highway Corridor Management | West Region | Engineering Office
Provincial Highways Management | Ministry of Transportation
1st Floor | 659 Exeter Road | London, ON, N6E 1L3
Telephone: 519-873-4598 | Toll Free: 1-800-265-6072 Ext. 4598
Fax: (519) 873-4228 | E-mail: zsolt.katzirz@ontario.ca

Please consider the environment before printing this email



Public Website: <http://www.mto.gov.on.ca/english/engineering/management/corridor/index.shtml>

From: Heather Goodman [mailto:hgoodman@ptsl.com]
Sent: March-27-18 3:48 PM
To: Katzirz, Zsolt (MTO)
Cc: Drea Nelson - GM BluePlan; Rajan Philips; John Slocombe - GM BluePlan
Subject: RE: 180043 (Riversdale Bridge) - Terms of Reference

Hi Zsolt,

I want to clarify that this is not a typical TIS where a development is being contemplated. The purpose of this analysis is to determine if the extension of Side Road 20 to a new intersection connection on Highway 9 is feasible from a transportation perspective, including sight lines, intersection spacing, traffic control, auxiliary lanes, etc. We want to ensure the study conforms to MTO's requirements, specifically the growth rate for the area. That way, if this alternative is selected for further analysis, the traffic study conforms to MTO requirements.

I can provide the following information regarding the intersection based on the site visit and analysis completed thus far. Attached is a figure of the study area:

- The proposed intersection would be located east of the Teeswater River, on the north side of Highway 9 as a direct southward extension of Side Road 20. There is an existing road allowance for this extension. The road allowance may have to be moved to the east to avoid the floodplains. (See attached parcel map).
- The proposed Side Road 20 extension would be a two-lane roadway.
- The proposed intersection would be a T-intersection, with stop-control on Side Road 20 and free flow on Highway 9. No auxiliary lanes would be required.
- This is approximately 235 metres east of Union Street and 780 metres west Moscow Side Road. There is a private driveway approximately 240 metres east of the proposed intersection. The location of the proposed intersection meets TAC minimum spacing requirements
- Sight distance of over 350 metres is provided in each direction. This exceeds TAC recommendations.
- The speed limit on Highway 9 at this location is 80 km/h east of the Teeswater River bridge and 70 km/h to the west.

Please let me know if you have any questions.

Thanks,

Heather Goodman, B.Eng., EIT, MITE
Transportation Consultant



Paradigm Transportation Solutions Limited

p: 416.479.9684 x502
m: 905.506.0454

From: Katzirz, Zsolt (MTO) [<mailto:Zsolt.Katzirz@ontario.ca>]
Sent: March 21, 2018 9:32 AM
To: Heather Goodman <hgoodman@ptsl.com>
Subject: RE: 180043 (Riversdale Bridge) - Terms of Reference

Hi Heather,

Prior to agreeing to a traffic impact study we need to see conceptual plans of what is being proposed.

If an intersection is being re-aligned (along the provincial highway) we need to review items such as (but not limit to) intersection spacing and site lines to determine if we agree in principle prior to asking for supporting data such as a traffic impact study.

Regards,

Zsolt Katzirz | Highway Corridor Management Planner
Highway Corridor Management | West Region | Engineering Office
Provincial Highways Management | Ministry of Transportation
1st Floor | 659 Exeter Road | London, ON, N6E 1L3
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Please consider the environment before printing this email



From: Heather Goodman [<mailto:hgoodman@ptsl.com>]

Sent: March-13-18 11:42 AM

To: Katzirz, Zsolt (MTO)

Cc: Rajan Philips; Drea Nelson - GM BluePlan; John Slocombe - GM BluePlan; Brent Willis - GM BluePlan;
jstrader@brockton.ca

Subject: 180043 (Riversdale Bridge) - Terms of Reference

Hi Zsolt,

Further to our phone discussion last week, Paradigm has been retained by the Municipality of Brockton to carry out a Transportation Impact Study to provide background information prior to the Municipal Class Environmental Assessment (EA) that the Municipality is undertaking to address an aging heritage bridge in Riversdale, located on Side Road 20, to the north of Highway 9, detailed in the enclosed project overview and work plan. The TIS is being undertaken prior to initiating the EA process to determine the technical feasibility of some of the potential alternatives that may be considered in the EA.

We ask that you please review the work plan to ensure the scope of the study is acceptable and provide comments if necessary.

In addition, we request the following information from MTO for our study:

- ▶ The following intersections will be included in the study, please confirm this is acceptable.
 - Highway 9 at Union Street (two-way Stop-controlled);
 - Highway 9 at High Street (two-way Stop-controlled);
 - Union Street at Melvin Street (two-way Stop-controlled); and
 - Side Road 20 on the subject bridge.
- ▶ The traffic impact study will be prepared to conform to MTO guidelines and will assess a 20-year horizon. Please confirm this is acceptable.
- ▶ Please provide the growth rate to be used for the study.

Due to the time sensitive nature of the project, we ask that you please provide comments at your earliest convenience. Please do not hesitate to contact me if you have questions relating to this project.

Regards,

Heather Goodman, B.Eng., EIT, MITE

Transportation Consultant



Paradigm Transportation Solutions Limited

5000 Yonge Street, Suite 1901, Toronto ON M2N 7E9

p: 416.479.9684 x502

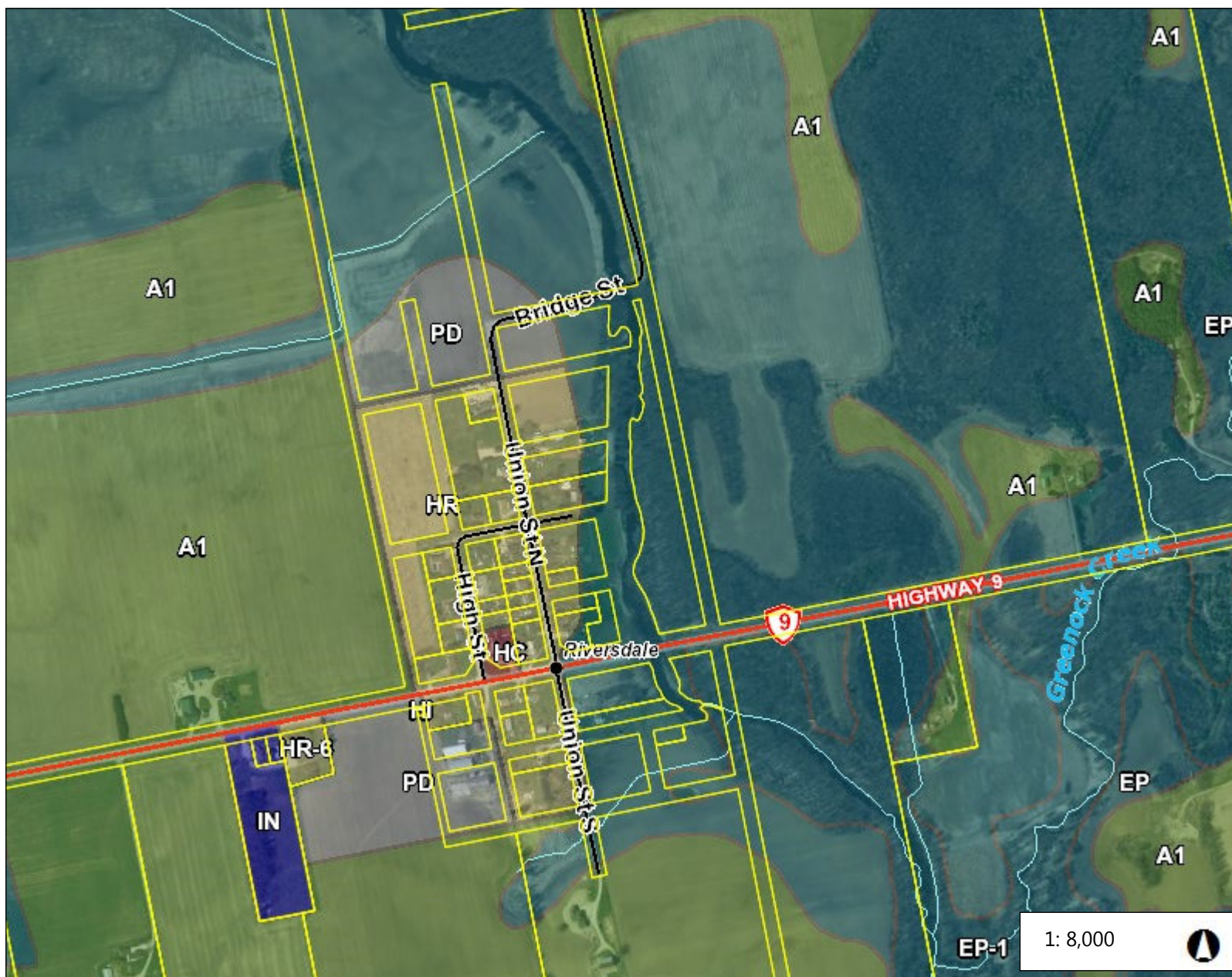
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Legend

- Ferry
- Provincial Highway
- County Road
- Municipal or Other Road
- Watercourse

- Permanent Stream
- Intermittent Stream

Zones (semi-transparent)

- Environmental Protection/Hazard
- Environmental Protection/Hazard H
- Wetland
- General Agriculture/Rural
- General Agriculture/Rural Holding
- Restricted Agriculture/Rural
- Restricted Agriculture/Rural Holding
- Hamlet Residential
- Mobile Home Park Residential
- Inland Lake Residential
- Lakeshore Residential
- Lakeshore Residential Holding
- Lifestyle Community Residential
- Lifestyle Community Residential Hc
- Resort/Cottage Residential
- Resort Residential Holding
- Office Residential
- Detached Residential

Notes

0.4 0 0.20 0.4 Kilometers

NAD_1983_UTM_Zone_17N
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This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

APPENDIX E:
NATURAL ENVIRONMENT – SUPPORTING INFORMATION

Bridge No. 0002 (Riversdale)

Municipality of Brockton
Environmental Assessment

Natural Heritage – Existing Conditions

Prepared for:
Municipality of Brockton
GM BluePlan

Project Number:
AA17-119A

Date:
January 18, 2018

ABOUD & ASSOCIATES INC.
Consulting Arborists • Ecologists • Landscape Designers

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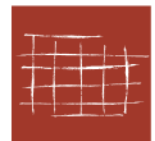


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1.0 Introduction

Aboud & Associates (AA) was retained by GM BluePlan on behalf of the Municipality of Brockton to complete a scoped Environmental Impact Study as part of an Environmental Assessment (EA). This Existing Conditions report has been compiled to support the development of alternatives presented in the Environmental Impact Study. The EA is being completed in order to determine the best course of action regarding the removal, repair or replacement of Bridge No. 0002 (Riversdale) as well as the potential for the re-alignment of Sideroad 20 to Highway 9.

1.1 Study Area and Existing Land Use

The existing bridge is part of Sideroad 20, and crosses the Teeswater River in the Village of Riversdale. The proposed bridge removal is within the Saugeen Valley Conservation Authority screening limit, and is designated as Hazard Lands in the Bruce County Official Plan (2013) as well as Environmental Protection in the Walkerton Community Official Plan (2013) and the Municipality of Brockton Zoning By-law (2013-26). The existing bridge is adjacent to unevaluated wetlands and is approximately 700 metres north of a portion of the Provincially Significant Greenock Swamp Wetland Complex. In addition to the unevaluated wetlands, the subject bridge is surrounded by annual row crop agriculture to the north, east and west.

1.2 Existing Regulations

1.2.1 Provincial Policy Statement

The *Provincial Policy Statement* ([PPS] OMMHA 2014) provides policy direction on matters of provincial interest related to land use planning and development.

Under the PPS, activities that create or maintain ‘*infrastructure*’ authorized under an environmental assessment process are not included under the Definition of Development, and are instead defined as ‘*infrastructure*’. Based on these definitions, the removal, repair or replacement of the existing bridge, along with the potential road re-alignment are governed by the policies for infrastructure.

The PPS states that:

“Natural features and areas shall be protected for the long term.”

And that:

“The diversity and connectivity of natural features in an area, and the long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features.”

The PPS (2014), Section 1.6: Infrastructure and Public Service Facilities, states that:

1.6.2 Planning authorities should promote 'green infrastructure' to complement 'infrastructure'

1.6.6.1 Planning for sewage and water services shall:

- a) direct and accommodate expected growth or development in a manner that promotes the efficient use and optimization of existing: 1. municipal sewage services and municipal water services; and 2. private communal sewage services and private communal water services, where municipal sewage services and municipal water services are not available;*
- b) ensure that these systems are provided in a manner that: 1. can be sustained by the water resources upon which such services rely; 2. is feasible, financially viable and complies with all regulatory requirements; and 3. protects human health and the natural environment;*
- c) promote water conservation and water use efficiency;*
- d) integrate servicing and land use considerations at all stages of the planning process; and*
- e) be in accordance with the servicing hierarchy outlined through policies 1.6.6.2, 1.6.6.3, 1.6.6.4 and 1.6.6.5.*

1.6.6.2 Municipal sewage services and municipal water services are the preferred form of servicing for settlement areas. Intensification and redevelopment within settlement areas on existing municipal sewage services and municipal water services should be promoted, wherever feasible.

1.6.8.4 The preservation and reuse of abandoned corridors for the purposes that maintain the corridor's integrity and continuous linear characteristics should be encouraged, wherever feasible.

1.6.8.5 When planning for corridors and right-of-way for significant transportation, electricity transmission, and 'infrastructure' facilities, consideration will be given to the significant resources in Section 2: Wise Use Management of Resources.

The PPS (2014), Section 2: Wise Use Management of Resources identifies the following as significant resources:

- a) significant wetlands;*
- b) significant woodlands;*
- c) significant valleylands;*
- d) significant wildlife habitat;*
- e) significant areas of natural and scientific interest; and*
- f) coastal wetlands,*

And states that:

2.1.6 Development and site alteration is not permitted in fish habitat, habitat of endangered species and threatened species except in accordance with provincial and federal requirements.

2.1.7 Development and site alteration is not permitted on adjacent lands to the natural heritage features and areas identified above, unless the ecological function of the adjacent lands has been evaluated and it has been demonstrated that there will be no negative impacts on the natural features or on their ecological functions.

2.2.2 Development and site alteration is restricted in or near sensitive surface water features and sensitive ground water features in order to protect the hydrologic functions of the feature. Mitigation and/or alternative development approaches may be required in order to protect, improve or restore sensitive surface water features, sensitive ground water features, and their hydrologic functions.

Under Section 1.6.8.5, these significant resources shall be given consideration in the planning of significant transportation *infrastructure*.

1.2.2 Endangered Species Act, 2007

The provincial Endangered Species Act, 2007 (ESA) provides protection to species designated as Threatened or Endangered on the Species at Risk in Ontario list (MNRF 2015a). The habitat of species at risk is also generally protected under the ESA. Protected habitat is habitat identified as essential for life processes including: breeding, rearing, feeding, hibernation and migration.

The ESA (Subsection 9(1)) states that:

“No person shall,

- (a) kill, harm, harass, capture or take a living member of a species that is listed on the Species at Risk in Ontario List as an extirpated, endangered or threatened species;*
- (b) possess, transport, collect, buy, sell, lease, trade or offer to buy, sell, lease or trade,*
 - (i) a living or dead member of a species that is listed on the Species at Risk in Ontario List as an extirpated, endangered or threatened species,*
 - (ii) any part of a living or dead member of a species referred to in subclause (i),*
 - (iii) anything derived from a living or dead member of a species referred to in subclause (i); or*
- (c) sell, lease, trade or offer to sell, lease or trade anything that the person represents to be a thing described in subclause (b) (i), (ii) or (iii).*

Clause 10(1) (a) of the ESA also states that:

“No person shall damage or destroy the habitat of a species that is listed on the Species at Risk in Ontario list as an endangered or threatened species.”

An authorization or permit between the proponent and the Minister of Natural Resources and Forestry is required to authorize activities that would otherwise be prohibited by Subsection 9(1) and 10(1) of the ESA.

1.2.3 Fisheries Act, 1985

The study area contains fish bearing waters in the form of the Teeswater River. These areas, and the fish within, are protected under the Federal Fisheries Act, 1985. The Fisheries Act provides protection for the sustainability and ongoing productivity of Canada's recreational, commercial and Aboriginal fisheries.

Section 35 (1) of the Fisheries Act States that:

"No person shall carry on any work, undertake activity that results in serious harm to fish that are part of a commercial, recreational or Aboriginal fishery, or fish that support such a fishery"

The Fisheries Act requires that projects and activities avoid causing serious harm to fish and fish habitat unless authorized to do so by the Department of Fisheries and Oceans Canada (DFO). This applies to work conducted in or near waterbodies that support recreational, commercial and Aboriginal fisheries. Within the context of Bridge No. 0002 and the potential road re-alignment, any proposed actions that could impact fish or fish habitat would need to be assessed for compliance with the Fisheries Act. If it is determined that proposed actions will cause serious harm to fish that cannot be mitigated for, then a Fisheries Act Authorization would be required.

1.2.4 Saugeen Valley Conservation Authority

The majority of the proposed study area is within the SVCA screening limit and contains a portion of the Greenock Swamp Provincially Significant Wetland Complex.

Section 3.7.2.3 of the Environmental Planning and Regulations Policies Manual (2017) states all wetlands and their associated areas of interference are regulated under the *Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation*. Any *development* or *interference* within wetlands or development in areas of interference requires permission from the SVCA.

An EIS to assess the hydrologic impact may be required if the submitted plans do not demonstrate the following:

- Disturbance to natural vegetation communities contributing to the hydrologic function of the wetland are avoided
- Overall existing drainage patterns for the lot will be maintained
- Disturbed area and soil compaction is minimized
- Development is located above the high water table
- All sewage disposal systems are located a minimum of 15 metres from the wetland and a minimum of 0.9 metres above the water table
- Impervious areas are minimized
- Best management practices are used to:
 - Maintain water balance
 - Control sediment and erosion
 - Maintain as much of the wetland buffer as possible

Section 4.15.1 Interference with Watercourses states watercourse crossings may be permitted if it has been demonstrated to the satisfaction of the SVCA that the interference is acceptable on the natural features and hydrologic and ecological functions of the watercourse. At a minimum, plans should demonstrate the following based on the morphological characteristics of the watercourse:

- i. Culverts have an open bottom where feasible and where it is not feasible, culverts are appropriately embedded into the watercourse;
- ii. Crossing location, width and alignment should be compatible with stream morphology which typically requires location of the crossing on a straight and shallow/riffle reach of the watercourse with the crossing situated at right angles to the watercourse;
- iii. The crossing is sized and located such that there is no increase in upstream or downstream erosion or flooding;
- iv. The design should consider fish and wildlife passage;
- v. Have regard for upstream and downstream effects when installing/replacing a culvert

1.2.5 Walkerton Community Official Plan

The study area is designated as Environmental Protection under the Walkerton Community Official Plan (2013). Section 3.9.3 states that certain buildings and structures that must be located within the Environmental Protection designation by the nature of their use, such as for flood or erosion control are permitted.

Section 3.9.4 states replacement of existing buildings or structures damaged by natural causes may be permitted if the hazard risk does not increase from the original condition and provided such replacement does not increase the height, size, volume or change the use. Extensions or enlargements may be subject to the requirements of Section 3.9.6.

Section 3.9.6 states an Environmental Impact Study (EIS) is required for new development proposed within the Environmental Protection designation.

1.2.6 County of Bruce Official Plan

According to the County of Bruce Official Plan (2013) Schedule 'A', the study area is within lands designated as Environmental Protection/Hazard.

The County of Bruce OP Section 5.8.3 indicates that Hazard Land Areas include those areas of identified Provincially Significant Wetlands and Environmental Hazard Areas such as flood and erosion susceptibility areas, hazard lands, steep slopes or other physical conditions which are severe enough to cause property damage or potential loss of life if the lands were to be developed.

Section 5.8.4 states that buildings and structures are generally not permitted in Hazard Area lands. Only those uses which do not impair ecological processes and the environmental features so identified will be permitted

Section 4.3.3 states that in order to achieve County objectives for the protection of the natural environment, development proponents shall be required to prepare an EIS for any proposal that is:

- i. In, or within 120 metres of, a provincially significant wetland;
- ii. In or within 60 metres of, a locally significant wetland;
- iii. In, or within 120 metres of, the habitat of threatened or endangered species;
- iv. In, or within, 120 metres of, a significant woodland, significant valleyland, significant wildlife habitat, deer wintering areas;
- v. In, or within, 120 metres of, fish habitat;
- vi. Within the '100 metre buffer zone or '2 year time of travel (WHPA-B)' for Wellhead Protection Areas or within an 'Intake Protection Zone 1 (IPZ-1)' or 'Intake Protection Zone 2 (IPZ-2)' for Intake Protection Zones;
- vii. Within known areas of karst topography;
- viii. In, or within, 50 metres of Areas of Natural and Scientific Interest (ANSI) Earth Science

Section 5.8.5 states that the replacement or rebuilding of an existing building destroyed by natural means beyond the control of the owner may be permitted providing it does not exceed the size or volume of the original building, is located at the same site, unless an environmentally more acceptable site is available and acceptable to the owner which will not aggravate the existing hazardous situation, and is for substantially the same use, subject to the approval of the local municipality and the appropriate approval authorities.

1.3 Terms of Reference

Based upon the above acts, policies and regulations, Terms of Reference (ToR) for the scoped EIS as part of the EA was developed and submitted to the Saugeen Valley Conservation Authority, Senior Manager, Gary Senior who passed them along to Regulations Officer, Michelle Gallant (ToR dated July 11, 2017). The SVCA responded to the ToR on October 11, 2017 with comments pertaining to changes in bridge design and potential restriction of the Teeswater River. The ToR and approval is provided in *Appendix 1*.

2.0 Methods

2.1 Background Review

A background information review was conducted of both biological and physical features within and adjacent to the study area. The following resources were consulted as part of this review:

1. Aerial photography of the subject site
2. Ministry of Natural Resources and Forestry (MNRF), Midhurst District
3. Natural Heritage Information Centre (NHIC) database (2017)
4. Ontario Reptile and Amphibian Atlas (Ontario Nature 2016a)
5. Ontario Mammal Atlas (1994)
6. Atlas of the Breeding Birds of Ontario, 2001-2005
7. Saugeen Valley Conservation Authority Regulation Mapping (SVCA 2017)
8. Bruce County Official Plan (2013) and Schedules
9. Municipality of Brockton Zoning By-law (2013-26)
10. Walkerton community Official Plan (2013)
11. Bruce County GIS mapping (Bruce County Maps, accessed July 5, 2017) of natural heritage features (e.g. wooded areas, MNRF evaluated wetlands, watercourses)
12. Land Information Ontario, Woodland and Wetland mapping, 2007

2.2 Vegetation

Ecological Land Classification (ELC) surveys were completed by qualified ecologist, Shannon Ferguson, OMNRF certified in Ecological Land Classification, on July 28 and October 20, 2017. Vegetation communities within the study area were characterized and delineated following the Ecological Land Classification (ELC) system for Southern Ontario (1st approximation); community codes used generally follow the 2nd approximation (Lee, et al., 1998, 2008). Boundaries of ELC communities were mapped using aerial images and field observations (Figure 1). A two-season inventory of vascular plants was also completed. Due to property access restrictions, the ELC and associated two-season botanical inventory were conducted as best as possible from the roadside. Detailed survey dates and weather information are provided in *Appendix 7*.

Identified ELC communities were cross referenced with the NHIC Ontario Plant Community List (NHIC 2015) to determine the presence of rare plant communities (S1- Critically Imperiled, S2- Imperiled, or S3- Vulnerable). The Subnational, or Provincial Ranks (S Rank) are assigned by the Ontario Ministry of Natural Resources and Forestry (MNRF) Natural Heritage Information Centre (NHIC) in order to help assign protection priorities. Detailed descriptions of each ELC community are provided in *Appendix 3*.

Identified vascular plant species were compared to provincial and federal SAR lists (COSSARO, SARA), provincial ranks (NHIC 2015), global ranks, and Distribution and Status of the Vascular Plants of Southwestern Ontario (Oldham 1993) in order to assess federal, provincial, regional and local conservation status of each species. English colloquial names and scientific binomials of plant species generally follow the Database of Vascular Plants of Canada (VASCAN 2016).

Identification of environmentally sensitive plant species was completed based on assignment of a coefficient of conservatism value (CC) for each native species (Oldham, et al., 1995). The value of CC, ranging from 0 (low) to 10 (high), is based on a species' tolerance of disturbance and fidelity to specific natural habitat parameters. Species with a CC value of 9 or 10 generally exhibit a high degree of fidelity to a narrow range of habitat parameters. These species may be more sensitive to environmental changes (Montarello, et al., 2010).

A list of all identified plant species is provided in *Appendix 4*. The list provides botanical names, common names, provincial rarity rank (S-rank), global rarity rank (G-rank), provincial Species at Risk status (SARO), federal Species at Risk status (SARA), coefficient of conservatism (CC) and coefficient of wetness (CW). Plant species that could only be identified to genus were not assigned the above information.

2.3 Provincially Significant Wetlands

A portion of the Provincially Significant Greenock Swamp Wetland Complex is within the study area located south of Highway 9. The wetland was originally evaluated in 1989, and was updated in August 1999 (Pers., Comm. Kathy Dodge 2017). A copy of the wetland evaluation data and scoring record was requested from the Midhurst District MNRF office, a copy of the evaluation map and vegetation community summary was provided and reviewed in order to determine the presence of potentially important biological and hydrological features. Following selection of the preferred alternative, through the EA process, the wetland area within 120m of the proposed road may require delineation, for approval by the SVCA and the MNRF.

2.4 Wildlife

2.4.1 Incidental Wildlife Observations

Incidental observations of insects, mammals, birds and reptiles were recorded during all field visits.

2.4.2 Significant Wildlife Habitat

With guidance from the *Significant Wildlife Habitat Technical Guide* (2000) and the SWH EcoRegion Criterion Schedule 6E (2015), the existing bridge and potential road realignment route as well as the immediately adjacent lands (30m) were considered for the presence of Significant Wildlife Habitat (e.g. specialized habitats for wildlife, and habitat for species of conservation concern). An assessment of the study area for all SWH is provided in *Appendix 5*.

2.4.3 Species at Risk Habitat

The existing bridge and potential road realignment route and immediately adjacent lands (within 50m) were reviewed for the presence of habitat that may be suitable for Species at Risk. Guidance was provided by the MNRF- Midhurst District, as to what SAR may have the potential to occur within Bruce County. A review of the site, along with habitat requirements for each species was conducted; a variety of sources, including the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) documents were used to determine habitat suitability. The site was then evaluated for potential habitat using Ecological Land Classification, guidance from MNRF documents, and on-site knowledge acquired through field surveys. An assessment of the study area of candidate habitat for SAR is provided in *Appendix 6*.

3.0 Existing Conditions

3.1 Background Review

3.1.1 Natural Heritage Information Centre - Species at Risk

Preliminary investigation through the Natural Heritage Information Centre (NHIC 2015) uncovered two provincial Species at Risk (SAR) records in the 1km x 1km squares (17MJ7381 & 17MJ7382) containing the study area. Habitat for the listed species was identified as occurring in the study area. Species and habitat requirements are summarized in *Table 1*.

Table 1. NHIC Species at Risk Records

| Scientific Name | Common Name | (COSEWIC) Status ¹ | (SARO) Status ² | Last Observed (NHIC) | S-Rank ³ | Habitat Requirements |
|------------------------------|-----------------|-------------------------------|----------------------------|----------------------|---------------------|---|
| <i>Dolichonyx oryzivorus</i> | Bobolink | Threatened | Threatened | June 26, 2004 | S4B | Nest in grassland habitats, including hayfields and meadows with a mixture of grasses and broad-leaved forbs with a high litter cover. Area Sensitive, with increased density in grasslands greater than 10ha (Renfrew et. al. 2015) |
| <i>Chelydra serpentina</i> | Snapping Turtle | Special Concern | Special Concern | June 23, 2004 | S3 | Associated by slow-moving water with a soft mud bottom and dense aquatic vegetation. Most often located in ponds, sloughs, shallow bays or river edges and slow streams, or areas combining several of these wetland habitats (COSEWIC 2008). |

¹ COSEWIC – Committee on the status of endangered wildlife in Canada

² SARO – Species at Risk Act Ontario

³ S-Rank – Denotes the conservation status of a species at the provincial level

S4: Apparently Secure—Uncommon but not rare

S#B- Breeding status rank

3.1.2 Ontario Breeding Bird Atlas

A list of birds determined to be breeding (Possible, Probable or Confirmed) in the 10km x 10km square containing the study area during the 2001-2005 Ontario Breeding Bird Atlas (Cadman 2007) was compiled. This list includes 94 species; nine of which are Species of Conservation Concern (Red-headed Woodpecker (SC), Eastern Wood-pewee (SC), Bank Swallow (THR), Barn Swallow (THR), Wood Thrush (SC), Golden-winged Warbler (SC), Grasshopper Sparrow (SC), Bobolink (THR) and Eastern Meadowlark (THR). 21 of the species identified in the square are considered Ontario PIF (Partners in Flight) priority species in Bird Conservation Region 13 (Environment Canada, 2008). The findings of this review are presented in *Appendix 2*.

3.1.3 Ontario Reptile and Amphibian Atlas

Review of the Ontario Reptile and Amphibian Atlas identified 13 species that are known to occur within the 10km x 10km square containing the study area. This list includes one species at risk under the ESA; Common Snapping Turtle (*Chelydra serpentina*) listed as Special Concern provincially and federally. Potential habitat for this species was identified in the study area. The findings of this review are presented in *Appendix 2*.

3.1.4 Atlas of the Mammals of Ontario

Review of the Atlas of the Mammals of Ontario (Dobbyn 1994) identified 14 species that are known to occur within approximately 10km of the study area. One of these is a Species at Risk provincially (Little Brown Myotis (END)). Females establish summer maternity colonies in large-diameter trees with peeling back bark, crevasses and cavities (COSEWIC 2013). Potential maternity habitat for bat species at risk may occur within the study area. The findings of this review are presented in *Appendix 2*.

3.1.5 Ministry of Natural Resources and Forestry

A request for information was sent to the MNRF- Midhurst District on July 7, 2017, to inquire whether any further Species at Risk may occur in the study area. A response was provided on July 19, 2017 with the details below. *Appendix 8* contains the full correspondence.

3.1.5.1 Species at Risk

The MNRF has no additional information regarding provincial SAR within the study area. Five SAR (Hungerford's Crawling Water Beetle (END), Northern Long-eared Bat (END), Tri-coloured Bat (END), Eastern Small Footed Bat (END and Eastern Ribbonsnake (SC)) were identified by the MNRF to have the potential to occur within the region, and should be considered during site assessment and analysis.

3.1.5.2 Fish Records

The MNRF does not have any fisheries information (fish dots) for this area. Their closest sampling location is in Kinlough Creek approximately 1.5km upstream. Common shiner, brook stickleback, and brassy minnow have been known to be present. The MNRF considers the Teeswater River to be a cool/warm water system in this area, with known populations of smallmouth bass and northern pike.

3.1.5.3 Wetlands

The MNRF acknowledges that the wetland in the area of this bridge location is an unevaluated wetland, but appears to be connected hydrologically to the Provincially Significant Greenock Swamp Wetland. The argument could be made that it should have been complexed as part of the PSW. The Greenock Swamp PSW is a very large wetland made up of mainly treed swamp communities.

3.2 Vegetation

3.2.1 Ecological Land Classification

The community polygons identified during the ELC survey are summarized in *Table 2* below. Field forms and a comprehensive vascular plant list for the entire study area are presented in *Appendices 3* and *4*, respectively.

| Table 2. Ecological Land Classification | | |
|---|-------------------------------|---|
| ELC Code | Vegetation Type | Community Description |
| <i>Deciduous Swamp (SWD)</i> | | |
| SWDM3a | Maple Mineral Deciduous Swamp | This community is located throughout the unevaluated wetland adjacent to the subject bridge. The canopy and sub-canopy are dominated by Silver Maple (<i>Acer saccharinum</i>) with Green Ash (<i>Fraxinus pennsylvanica</i>) and White Elm (<i>Ulmus americana</i>) with sparse Eastern White Cedars (<i>Thuja occidentalis</i>) also in the sub-canopy. The understorey includes Green Ash, Red-osier Dogwood (<i>Cornus sericea</i>), Manitoba Maple (<i>Acer negundo</i>) and Black Walnut (<i>Juglans nigra</i>) with False Nettle (<i>Boehmeria cylindrica</i>), Reed-canary Grass (<i>Phalaris arundinacea</i>), Summer Grape (<i>Vitis aestivalis</i>) and Hemlock Water-parsnip (<i>Sium suave</i>) in the ground layer. |
| SWDM3b | Maple Mineral Deciduous Swamp | This community occurs within the portion of Greenock Swamp PSW immediately south of Highway 9. The canopy and sub-canopy are predominantly Silver Maple with occasional White Elm with Manitoba Maple also occurring in the sub-canopy. The understorey consists of Manitoba Maple and Trembling Aspen (<i>Populus tremuloides</i>) with the ground layer being comprised of Sensitive Fern (<i>Onoclea sensibilis</i>), Reed-canary Grass, Grass species and False Nettle. |
| <i>Graminoid Meadow (MEG)</i> | | |
| MEGM3 | Dry- Fresh Graminoid Meadow | This community occurs as an upland opening surrounded by the Greenock Swamp PSW south of Highway 9. This community lacks both a canopy and sub-canopy, however the understorey is comprised of Raspberry species (<i>Rubus sp.</i>), Green Ash and Trembling Aspen. The ground layer is dominated by grass species with Goldenrod species (<i>Solidago sp.</i>), Reed-canary Grass and Wild Carrot (<i>Daucus carota</i>) throughout. |
| <i>Deciduous Woodland (WOD)</i> | | |
| WODM4 | Dry- Fresh Deciduous Woodland | This community is located in the south-west corner of the study area, bordering Highway 9 and Union Street South. The Canopy and sub-canopy both consist of Silver Maple and White Elm with an understorey that includes Canada Goldenrod (<i>Solidago canadensis</i>), Summer Grape, European Buckthorn (<i>Rhamnus cathartica</i>) and Spotted Joe-Pye-Weed (<i>Eutrochium maculatum var. maculatum</i>). The dense ground layer is comprised of Grass species, Reed-canary Grass, Canada Goldenrod and Awnless Brome (<i>Bromus inermis</i>) |

3.2.1.1 Species at Risk, Regional and Local Significance

No vegetation communities listed above are considered rare in the province.

Forty-nine (49) vascular plants were identified to species within the study area during the botanical inventory. Of those identified, 31 species or 67% were native and 15 species or 33% were exotic. Most of the native species are ranked S5 (Secure in Ontario) or SNA (S-rank not applicable) with three species, Green Ash (*Fraxinus pennsylvanica*), Black Walnut (*Juglans nigra*) and Summer Grape (*Vitis aestivalis*) ranking S4 (apparently secure in Ontario), and one species – Virginia Creeper (*Parthenocissus quinquefolia*) – is ranked S4?, indicating uncertainty in its ranking. No S1-S3 species were observed in the study area. No species observed has coefficient of conservatism of 9 or 10.

No national or provincially rare, threatened or endangered species were found.

3.3 Provincially Significant Wetland

3.3.1 Wetland Characteristics

The digital version of the Greenock Swamp PSW evaluation file was provided by Kathy Dodge, MNRF- Midhurst District. Although there is no detailed map outlining the vegetation communities, the evaluation and summary describe the PSW as a whole. The summary states that the wetland is classified as a Life Science Area of Natural and Scientific Interest because of the large number of plant and animal species that inhabit it, and it is also an important source of timber and commercial fish.

The wetland is 100% organic soils and contains all four wetland types: swamp (96%), marsh (3.9%), fen (0.08%) and bog (0.02%) which are connected by surface waters. The wetland contains 273 vegetation communities, which are a result of the abundance of diverse habitats within the wetland area.

The wetland serves as a headwater for many streams and drains into the Teeswater River. The abundance of organic soils throughout allows the wetland to be a tremendous long-term nutrient trap.

The wetland is recognized to contain significant winter cover for White-tailed Deer and has been known to contain habitat for Least Bittern (THR), Cerulean Warbler (THR), Red-shouldered Hawk (SC) and Black Tern (SC).

3.4 Wildlife

3.4.1 Incidental Wildlife Observations

Incidental wildlife observations made outside of the above formal field surveys are presented in *Table 3*. All observations were of single individuals unless otherwise stated. None of these species are designated Species at Risk.

Table 3. Incidental Species with Conservation Designation Observations

| Common Name | Scientific Name | Taxa | Date | Location/Notes |
|---------------------|-------------------------------|---------|------------|--|
| Mourning Dove | <i>Zenaida macroura</i> | Bird | 28/07/2017 | Observed during summer ELC/botanical survey |
| American Crow | <i>Corvus Brachyrhynchos</i> | Bird | 28/0/2017 | Observed during summer ELC/botanical survey |
| Gray Catbird | <i>Dumetella carolinensis</i> | Bird | 28/07/2017 | Observed during summer ELC/botanical survey |
| Eastern Gartersnake | <i>Thamnophis sirtalis</i> | Reptile | 28/07/2017 | Observed on road shoulder during summer ELC/botanical survey |
| Barn Swallow | <i>Hirundo rustica</i> | Bird | 20/10/2017 | Evidence of nesting on underside of Bridge No. 0002. Listed at THR provincially and federally. |
| Gray Squirrel | <i>Sciurus carolinensis</i> | Mammal | 20/10/2017 | Observed during fall ELC/botanical survey |

3.4.2 Significant Wildlife Habitat

With guidance from the *Significant Wildlife Habitat Technical Guide* (2000) and the SWH EcoRegion Criterion Schedule 6E (2015), we have determined that Significant Wildlife Habitat (SWH) is not present immediately adjacent the existing bridge, however it is present within the portion of the Greenock Swamp PSW south of Highway 9.

The portion of Greenock Swamp PSW within the study area is confirmed Significant Wildlife Habitat for Deer Wintering Areas. Deer management is an MNRF responsibility and all deer wintering areas considered significant are mapped by MNRF. Due to this area being designated as a Wintering Area, it also has the potential to be a Deer Movement Corridor. See *Appendix 5* for a detailed assessment of Significant Wildlife Habitat.

3.4.3 Species at Risk Habitat

Habitat requirements, breeding evidence and a habitat assessment of one species at risk, Barn Swallow, are discussed below. No other federal or provincially listed plant or fish species were identified within the study area through background research, provided data, or field observations.

3.4.5.1 Barn Swallow

Barn Swallow is listed as Threatened provincially (ESA 2007) and their general habitat is afforded protection under the ESA. The species typically selects nesting and foraging sites close to open habitats such as farmlands, wetlands, road rights-of-way, large forest clearings. Although they continue to nest in natural situations, they are now most closely associated with a variety of artificial structures including open barns, garages, sheds, bridges and road culverts.

This species is a confirmed breeder on the underside of the current bridge structure. Photos of this nesting evidence can be found in *Appendix 9*.

3.5 SAR Habitat Assessment

An assessment of all Species at Risk, and species with conservation designation, that have the potential to occur in the study area based on lists provided by MNRF and the NHIC was completed, and is provided in *Appendix 6*. Species assessed include all species with Provincial SARO status, Federal SARA status, or an S-rank of S1-S3. Species assessed with the potential to occur in the study area, but that were not observed during field studies are discussed in detail below.

3.5.1 Vegetation

3.5.1 Butternut

Butternut is listed as Endangered provincially (ESA 2007) and federally (Species at Risk Public Registry 2017). Butternuts primarily occur in rich, moist, well drained soils, often along streams (MNRF 2015a). Habitat for Butternut may be present along the watercourse throughout the study area. Access to the communities adjacent the watercourse was not obtained and therefore these communities were not thoroughly inventoried. MNRF Butternut records in Ontario mapping showed no known butternut populations in the general proximity of the subject bridge.

3.5.2 Wildlife

3.5.2.1 Bobolink

Bobolink is listed as Threatened provincially (ESA 2007). Bobolink typically nest in open grasslands and hay fields and are an area-sensitive species, preferring grassland habitat >10ha in area. The surrounding agricultural fields may provide suitable habitat for Bobolink. Bobolink was not observed incidentally within potential habitat during any surveys completed.

3.6.2.2 Eastern Meadowlark

Eastern Meadowlark is listed as Threatened provincially (ESA 2007). Eastern Meadowlark typically nest in open grasslands and hay fields and are also an area-sensitive species, preferring grassland habitat > 10ha in area. The surrounding agricultural fields may provide suitable habitat for Eastern Meadowlark. Eastern Meadowlark was not observed incidentally within potential habitat during any surveys completed.

3.6.2.3 Short-eared Owl

Short-eared Owl is listed as Special Concern provincially (ESA 2007) and federally (Species at Risk Registry, 2017). Short-eared Owls breed in a large number of open habitats including grasslands and also occasionally breed in agricultural fields. The surrounding agricultural fields may provide suitable habitat for Short-eared Owls. Short-eared Owls were not observed incidentally within potential habitat during any surveys completed.

3.6.2.4 *Eastern Small-footed Myotis*

Eastern Small-footed Myotis is listed as Endangered provincially (ESA 2007). This species is associated with hilly or mountainous terrain, in or near coniferous or deciduous forest habitat. Maternity roosts located in cracks and crevices of talus slopes and rocky outcrops, or, occasionally, in bridges, old buildings, hollow trees (or loose bark) and caves and mines, during the maternity season. They hibernate singly or in small clusters in mines and caves (NatureServe, 2015). Deciduous trees as well as the current bridge structure may provide suitable maternity habitat within the study area. No surveys for bats or bat habitat were conducted in the study area; this species was not observed incidentally within potential habitat during any surveys completed.

3.6.2.5 *Little Brown Myotis*

Little Brown Myotis is listed as Endangered provincially (ESA 2007) and federally (Species at Risk Public Registry, 2017). Little Brown Myotis hibernate in Caves. Maternity colonies are located in warm sites, often associated with human habitation, including attics, old buildings, under bridges, rock crevices and cavities in canopy trees in wooded areas (COSEWIC, 2013c). Deciduous trees within the study area may provide suitable maternity habitat for this species. No surveys for bats or bat habitat were conducted in the study area; this species was not observed incidentally within potential habitat during any surveys completed.

3.6.2.6 *Northern Myotis*

Northern Myotis is listed as Endangered provincially (ESA 2007) and federally (Species at Risk Public Registry, 2017). Northern Myotis hibernate in caves and maternity colonies are usually located in trees, which are closely associated with specific tree characteristics and density of suitable trees. Woodlands characterized by tall, large diameter trees in early stages of decay, located in openings in mature forest canopies are preferred (COSEWIC, 2013c). Deciduous trees within the study area may provide suitable maternity habitat for this species. No surveys for bats or bat habitat were conducted in the study area; this species was not observed incidentally within potential habitat during any surveys completed.

3.6.2.7 *Blanding's Turtle*

Blanding's Turtle is listed as Threatened provincially (ESA 2007) and federally (SARA). Blanding's Turtles use a variety of eutrophic wetland habitat types, including lakes, ponds, watercourses, marshes, man-made channels, farm fields, coastal areas and bays. Seasonal overland terrestrial movements up to 2.5 km occur to reach nesting and overwintering areas, generally through wooded coniferous or mixed forest habitat. Nests are usually laid in loose sand or organic soil (COSEWIC 2005b). The abundance of swamp habitat as well as the Teeswater River may provide suitable habitat within the study area for seasonal overland movements. No surveys were conducted for Blanding's Turtle in the study area. Blanding's Turtle was not observed incidentally within potential habitat during any surveys completed.

3.6.2.8 Eastern Ribbonsnake

Eastern Ribbonsnake is listed as Special Concern provincially (ESA 2007) and federally (Species at Risk Public Registry, 2017). Eastern Ribbonsnake is a semi-aquatic species that inhabits dense, low- vegetation, edges of ponds, streams, marshes, fens and bogs, with open sunlit areas for basking (COSEWIC 2002c). The edges of the Teeswater River may provide suitable habitat for this species within the study area. No surveys for snakes were conducted in the study area. Eastern Ribbonsnake was not observed incidentally within potential habitat during any surveys completed.

3.6.3 Fish

3.6.3.1 Redside Dace

Redside Dace (*Clinostomus elongatus*) is listed as Endangered provincially (ESA 2007) and federally (Species at Risk Registry, 2017). Redside Dace inhabit cool to cold water tributaries. The stream segments within the study area are identified as cool/warm water and would not likely be suitable for Redside Dace. MNRF Redside Dace records in Ontario mapping has shown no known Redside Dace populations in the upper tributaries of the Teeswater River.

3.6.3.2 Northern Brook Lamprey

Northern Brook Lamprey (*Ichthyomyzon fossor*) is listed as Special Concern provincially (ESA 2007) and federally (Species at Risk Registry, 2017). The Northern Brook Lamprey lives in cool water, slow moving streams with soft substrate such as silt or sand. Spawning occurs in fast flowing riffle areas comprised of rock or gravel. Appropriate habitat is present along the Teeswater River within the study area, although the water may be too warm as it is classified as cool/warm water.

3.7 Landscape Evaluation

3.7.1 Ecoregion

The study area is located within Ecoregion 6E. This is the second most densely populated ecoregion in Ontario (MNRF 2009), containing a number of large urban centers. The climate of the ecoregion is mild and moist with mean annual precipitation between 759 to 1,087 mm. The underlying geology of the ecoregion is dolomite and limestone, with deep glacially deposited surface soils covering the bedrock in most areas.

Forest cover of the ecoregion is approximately 30.1% and composed of a diverse mixture of hardwood forests, lowlands and flood plain forest. Common tree species within the Ecoregion include; Sugar Maple (*Acer saccharum*), American Beech (*Fagus grandifolia*), White Ash (*Fraxinus americana*), Eastern Hemlock (*Tsuga canadensis*), Green Ash (*Fraxinus pennsylvanica*), Silver Maple (*Acer saccharinum*), Red Maple (*Acer rubrum*), Eastern White Cedar (*Thuja occidentalis*), Yellow Birch (*Betula alleghaniensis*), Balsam Fir (*Abies balsamea*), and Black Ash (*Fraxinus nigra*) (MNRF 2009).

3.7.2 Geology and Soils

The study area consists of four soil types including Bottomland (watercourse), Harriston loam (west side of watercourse), Muck (east side of watercourse) and Toledo silt loam (north of subject bridge). Bottomland soils are low lying soils along stream courses with typically poor drainage. Harriston loams are formed from loamy calcareous till and exhibit good external and internal drainage. Muck soils are comprised of well decomposed organic materials and have very poor drainage. Muck soils are typically under water for part of the year. Toledo silt loam is a coarse yet poorly draining gleysolic soil. Despite poor drainage, it is fairly well-supplied with plant nutrients.

3.7.3 Connectivity and Existing Natural Features

Natural features of the study area such as the Significant Woodland, the Teeswater River and the Provincially Significant Greenock Swamp Wetland serve as linkage corridors within the broader landscape. The proposed route for the road realignment within the study area currently provides an excellent natural corridor to a larger unevaluated wetland to the north as well as the Greenock Swamp PSW to the south. Another large unevaluated wetland also occurs to the east of the Study Area (Figure 2). The wetlands within the study area positively impact the flow regime within the watercourse through moderating flow during high and low periods, reducing flash flows and low water levels.

3.8.4 Significant Features

The Greenock Swamp within the study area is a significant feature provincially and in the Official Plans of Walkerton Community (2009) and Bruce County (2013). Portions of the forest surrounding the subject bridge are considered Significant Woodlands in the Bruce County Official Plan (2013). No other identified significant landscape features are present surrounding the subject bridge.

4.0 Summary and Conclusion

The following is a summary of the existing natural heritage conditions assessed and identified within the study area of the Bridge No. 0002, Environmental Assessment.

4.1 Summary of Existing Conditions

4.1.1 Vegetation

A two-season ELC evaluation and botanical inventory was completed throughout the Study Area. No offsite adjacent lands were investigated due to access restrictions.

1. Four natural or naturalized vegetation communities were identified, characterised and mapped. None of the ELC communities are considered provincially rare.
2. 46 species or distinct sub-species of plants were identified within the study area through field inventory. 67% of identified species are native to Ontario, with the remaining 33% of identified species exotic to Ontario.

4.1.2 Wetlands

1. The Provincially Significant Greenock Swamp is a core natural feature within the study area and surrounding landscape.
2. The wetland was originally evaluated by the MNRF in 1989 and was updated using the Ontario Wetland Evaluation System (OWES) by MNRF in August 1999.
3. Within the study area the wetlands consist of mineral and organic Deciduous Swamp.

4.1.3 Wildlife

1. Four bird, one snake, one turtle one mammal species were observed in the study area over the course of all field investigations.
2. Evidence of one species listed under the ESA was identified during field investigations: Barn Swallow (THR)
 - a. Barn Swallow nests were observed on the underside of the current bridge structure.
3. No species observed during field investigations are considered Area Sensitive.
4. No species observed during field investigations are Partners in Flight (PIF) Priority species.

4.1.4 Significant Wildlife Habitat (SWH)

1. A review of the study area using a combination of methods presented in the Ecoregion 6E criteria guide, air photo interpretation and field investigations assessed the study area for Significant Wildlife Habitat that may occur in ecoregion 6E.
2. A total of eight types of SWH were identified as candidate in the study area, one was confirmed significant using the results of all surveys completed in the study area and background resources.
3. Deer Overwintering Areas were identified as candidate and confirmed through Land Information Ontario mapping, and delineated within the study area.
4. Candidate Bat Maternity Habitat, Seeps and Springs, Amphibian Breeding Habitat (wetland), Terrestrial Crayfish, Special Concern & Rare Wildlife Species, Amphibian Movement Corridor and Deer Movement Corridor potentially occur within the study area but have not been confirmed. Further surveys may be required pending preferred alternative.

4.1.5 Species at Risk Habitat Assessment

1. A review of the study area was completed, using habitat requirements from reference documents, air photo interpretation and field investigations, to assess for habitat that may be suitable for Species at Risk. This list included all species identified through background review as occurring in Bruce County (Pers. Comm., Kathy Dodge, 2017), identified in Wildlife Atlases or identified through NHIC (2015) that may occur in the study area.
2. Potential habitat for 13 species was identified in the study area. The underside of Bridge No. 0002 was thoroughly search for Barn Swallow nesting evidence and ELC and botanical surveys were conducted with incidental wildlife observations being recorded.
3. During all surveys completed in the study area by AA, one of the wildlife species with candidate habitat was identified in the study area. Nesting evidence of Barn Swallow was observed on the underside of the existing bridge structure.

4.2 Summary of Significant Features

A summary of existing conditions of natural heritage features are provided in Section 4.1. Several natural heritage features are considered significant, including but not limited to, Species at Risk listed under Ontario's Endangered Species Act and Significant Wildlife Habitat under the Provincial Policy Statement. In addition to the natural heritage features present within the study area, features identified as significant are provided varying levels of protection and management. A summary of significant features is provided in Table 7.

Table 4. Summary of Significant Features

| Significance /Type | Site Assessment and Observations | Legislation, Policy and Management Considerations |
|---|--|---|
| Species at Risk | <ul style="list-style-type: none"> •Barn Swallow (THR) observed breeding evidence on underside of existing bridge structure | <p><i>Endangered Species Act, 2007</i></p> <ul style="list-style-type: none"> •Threatened (THR) and Endangered (END) species are afforded General Habitat Protection under the ESA. <p><i>Provincial Policy Statement, 2014</i></p> <ul style="list-style-type: none"> •The habitat of Species listed as Special concern is protected under the PPS as Significant Wildlife Habitat. |
| Fish Habitat | <ul style="list-style-type: none"> • Teeswater River within and surrounding the study area is considered a cool/warm water system. •Teeswater River within and surrounding the study area contains known populations of smallmouth bass and northern pike. | <p><i>Fisheries Act, 1985</i></p> <ul style="list-style-type: none"> •Protects the productivity of recreational, commercial and Aboriginal fisheries. Fish communities and habitat within the study area are afforded protection. • Construction must respect the Warmwater/ coolwater fisheries timing window of no in-water work from March 15 – July 15. |
| Significant Wildlife Habitat (SWH) | <ul style="list-style-type: none"> •Deer Overwintering Areas | <p><i>Provincial Policy Statement, 2014</i></p> <ul style="list-style-type: none"> •Under the PPS, "Public Infrastructure including but not limited to roads, sanitary sewers, utilities, water supply wells, well house, and pipeline ...may be permitted in accordance with the policies in Section 7.1.2 - 7.1.3 – General Policies, provided that it can be demonstrated that: <ul style="list-style-type: none"> a) an Environmental Assessment or other comprehensive plan supported by the SVCA, demonstrates that all alternatives to avoid wetland loss or interference have been considered and that the proposed alignment minimizes wetland loss or interference to the greatest extent possible, and b) where unavoidable, intrusions on significant natural features or hydrologic or ecological functions are minimized and it can be demonstrated that best management practices including site and infrastructure design and appropriate remedial measures will adequately enhance features and functions. |

| Significance /Type | Site Assessment and Observations | Legislation, Policy and Management Considerations |
|--|--|---|
| Landscape Features | <ul style="list-style-type: none"> The natural lands within the study area are contiguous with surrounding natural features such as Provincially Significant Wetlands, fish habitat and Significant Woodlands. | <p><i>Bruce County Official Plan (2013)</i></p> <ul style="list-style-type: none"> Requires that EIS's include: "A description of the environment that will be affected or that might reasonably be expected to be affected, directly or indirectly. The effects that will be caused or that might reasonably be expected to be caused to the environment. The actions that are necessary or that may be reasonably be expected to be necessary to prevent, change, mitigate or remedy the effects of the effects that might reasonably be expected upon the environment by the under taking". <p><i>Provincial Policy Statement, 2014</i></p> <ul style="list-style-type: none"> Under the PPS, "The diversity and connectivity of natural features in an area, and long-term ecological function and biodiversity of natural heritage systems, should be maintained, restored or, where possible, improved, recognizing linkages between and among natural heritage features and areas, surface water features and ground water features. |
| Provincially Significant Wetlands | <ul style="list-style-type: none"> The Provincially Significant Greenock Swamp is within the study area. The area of interference (i.e. the areas surrounding wetlands where development could interfere with the hydrological function) is 120m. | <p><i>Bruce County Official Plan (2013)</i></p> <ul style="list-style-type: none"> Development may be permitted on adjacent lands only if it does not result in any of the items stated in Section 4.3.2.5. <p><i>Saugeen Valley Conservation Authority (2017)</i></p> <ul style="list-style-type: none"> Under the PPS, "Public Infrastructure including but not limited to roads, sanitary sewers, utilities, water supply wells, well house, and pipeline, within 30 metres of the boundary of a wetland...may be permitted if the interference on the hydrologic functions of the wetland has been deemed acceptable by the SVCA. |

4.3 Conclusion

The Natural Heritage – Existing Conditions report was completed as part of an Environmental Assessment to determine the best course of action regarding the removal, repair or replacement of the existing Bridge No. 0002. This EA is also evaluating the potential for a road realignment connecting Sideroad 20 to Highway 9.

The Natural Heritage - Existing Conditions Report has identified significant species, features and ecological functions within the study area, all of which should be considered in ranking potential options and the selection of the preferred options.

Prepared By:

ABOUD & ASSOCIATES INC.



Shannon Davison B.Env., Eco. Rest. Cert.
Ecologist
MNRF Certified Ecological Land Classification
MNRF Certified Wetland Evaluation

Reviewed By:

James Dennis, M. Sc.F
MNRF Certified Ecological Land Classification

5.0 References

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Personal Communications:

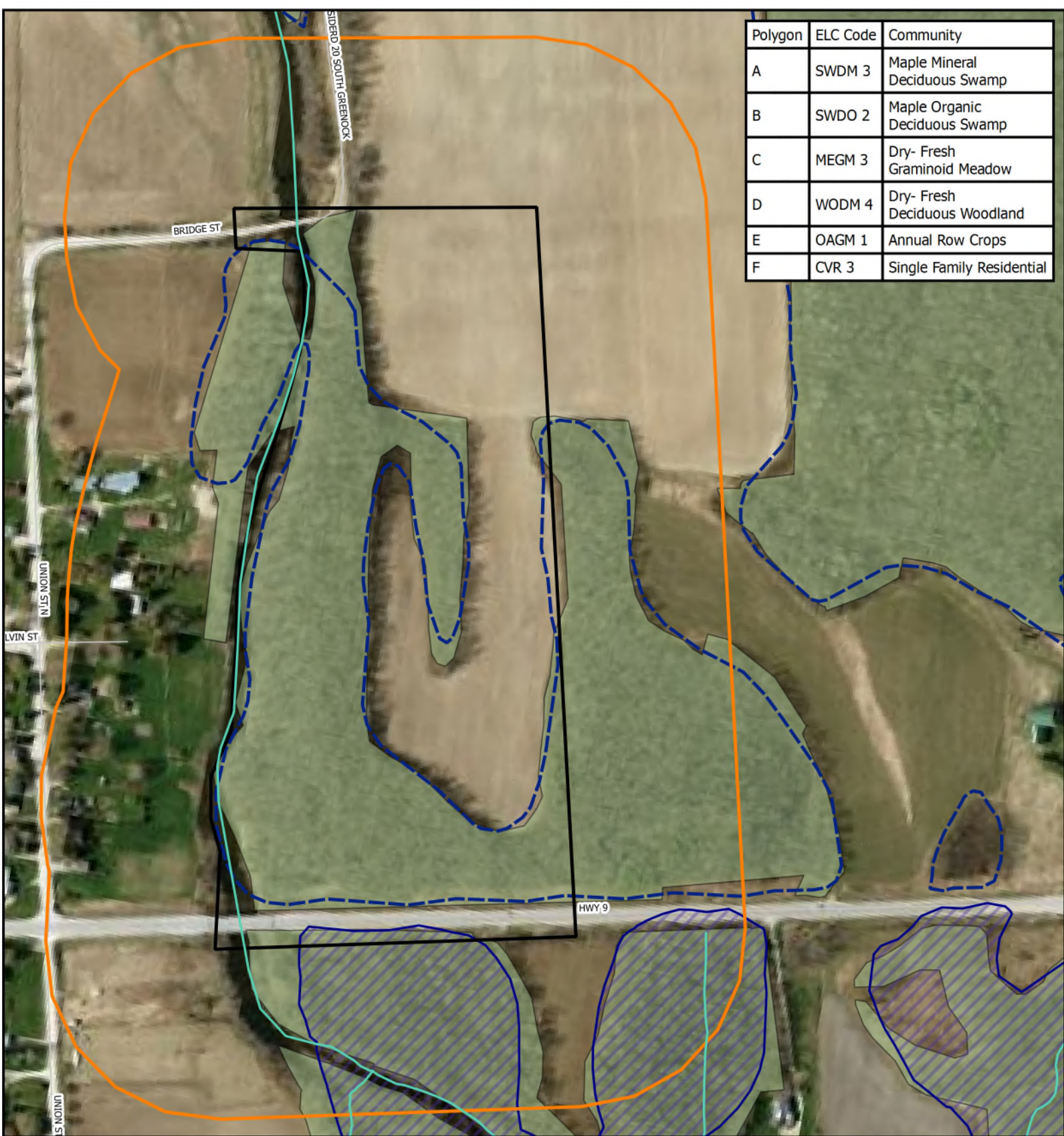
Nelson, Andrea. Senior Hydrogeologist, GM BluePlan Engineering Limited. E-mail correspondence.

Gallant, Michelle. Regulations Officer. Saugeen Valley Conservation Authority, E-mail and phone correspondence.

Dodge, Kathy. Management Biologist. Ministry of Natural Resources and Forestry, Midhurst District. Email Correspondence.

FIGURES

| Polygon | ELC Code | Community |
|---------|----------|-------------------------------|
| A | SWDM 3 | Maple Mineral Deciduous Swamp |
| B | SWDO 2 | Maple Organic Deciduous Swamp |
| C | MEGM 3 | Dry- Fresh Graminoid Meadow |
| D | WODM 4 | Dry- Fresh Deciduous Woodland |
| E | OAGM 1 | Annual Row Crops |
| F | CVR 3 | Single Family Residential |



LEGEND

| | | | |
|--|--------------------------------|--|---------------------------------|
| | WATERCOURSE | | BARN SWALLOW NESTING EVIDENCE |
| | STUDY AREA (120M) | | PSW AREA OF INTERFERENCE (120M) |
| | ECOLOGICAL LAND CLASSIFICATION | | PROVINCIALY SIGNIFICANT WETLAND |
| | SUBJECT AREA | | DEER OVERWINTER AREA |
| | UNEVALUTATED WETLAND | | WOODLAND |

Information Sources:

1. Orthophotography provided by First Base Solutions, accessed November 2017
2. ELC Communities provided by Aboud & Associates, July 2017
3. Woodlands, Watercourse, Wetlands & Deer Wintering Areas provided by Land Information Ontario, accessed November 2017



DATE: JANUARY 2018

PROJECT: AA17-119A

SCALE: 1:5000

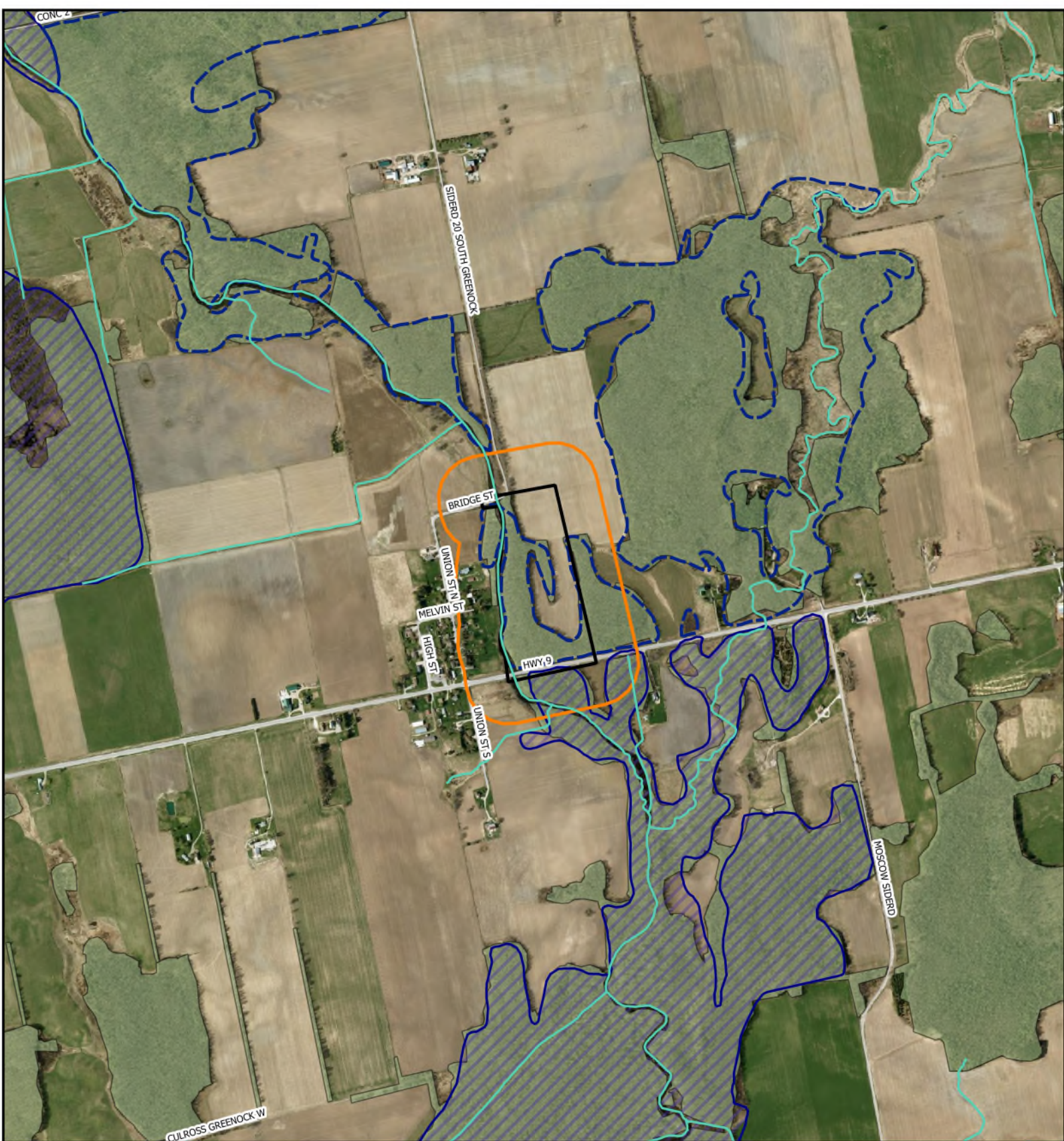


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Figure:

1



LEGEND

| | | | |
|--|---------------------|--|---------------------------------|
| — | WATERCOURSE | | PROVINCIALY SIGNIFICANT WETLAND |
| | STUDY AREA (120M) | | DEER OVERWINTER AREA |
| | SUBJECT AREA | | WOODLAND |
| | UNEVALUATED WETLAND | | |

Information Sources:

1. Orthophotography provided by First Base Solutions, accessed November 2017
2. Woodlands, Watercourse, Wetlands & Deer Wintering Areas provided by Land Information Ontario, accessed November 2017



DATE: JANUARY 2018

PROJECT: AA17-119A

SCALE: 1:20,000



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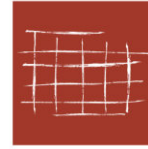
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Figure:

2

APPENDIX 1
Terms of Reference and Approval



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URBAN FORESTRY
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MONITORING

ECOLOGICAL RESTORATION
NATURAL SYSTEMS DESIGN
HABITAT RESTORATION
EDGE MANAGEMENT PLANS
RAVINE STEWARDSHIP PLANS
NATURALIZATION PLANS
INTERPRETIVE DESIGN
MONITORING
CONTRACT ADMINISTRATION

ENVIRONMENTAL STUDIES
SUBWATERSHED STUDIES
ENVIRONMENTAL IMPACT
STATEMENTS
ECOLOGICAL LAND
CLASSIFICATION
WETLAND EVALUATION
VEGETATION ASSESSMENT
BOTANICAL INVENTORIES
WILDLIFE SURVEYS
MONITORING

LANDSCAPE ARCHITECTURE
MASTER PLANNING
RESIDENTIAL COMMUNITIES
COMMERCIAL/INDUSTRIAL
HEALTHCARE AND EDUCATION
STREETSCAPES
PARKS AND OPEN SPACES
TRAIL SYSTEMS
GREEN ROOFS
CONTRACT ADMINISTRATION

EXPERT OPINION
OMB TESTIMONY
LEGAL PROCEEDINGS
PEER REVIEW
RESEARCH
EDUCATION

July 11, 2017

Our Project No.: AA17-119A
Sent by e-mail: G.Senior@svca.on.ca

Gary Senior
Sr. Manager
Flood Warning and Land Management
Saugeen Valley Conservation Authority
1078 Bruce Rd 12, Formosa ON N0G 1W0

**Re: Riversdale Bridge No. 0002 EA, Municipality of Brockton, Bruce
County
Terms of Reference - Scoped Environmental Impact Study**

Dear Gary Senior:

This document outlines the Terms of Reference (ToR) of the Scoped Environmental Impact Study (EIS) for an Environmental Assessment to determine the best course of action regarding the removal, repair or replacement of the Riversdale Bridge No.002 located within Lot 30, Concession 1N and the proposed bridge replacement or road re-alignment. Please review the revised terms and circulate to SVCA staff for discussion and approval.

BACKGROUND

It is anticipated that the existing bridge, part of Sideroad 20 West, crossing the Teeswater River in the Village of Riversdale will need to be removed. Following bridge removal, bridge replacement or road re-alignment will be considered.

The proposed bridge removal is within the Saugeen Valley Conservation Authority screening limit, and is designated as Hazard Lands in the Bruce County Official Plan (2013) as well as Environmental Protection in the Walkerton Community Official Plan (2013) and the Municipality of Brockton Zoning By-law (2013-26).

In Preparing the Terms of Reference, the following sources were reviewed for background information:

- Aerial photography of the subject site,
- Bruce County Official Plan (2013) and Schedules
- Municipality of Brockton Zoning By-law (2013-26)
- Walkerton Community Official Plan (2013)
- Bruce County GIS mapping (Bruce County Maps, accessed July 5, 2016) of natural heritage features (e.g. wooded areas, MNR evaluated wetlands, watercourses)
- SVCA mapping (accessed July 5, 2017) of regulation limit
- Natural Heritage Information Center, Make-a-map, accessed June 23, 2017,
- Ontario Nature. Ontario Reptile and Amphibian Atlas: a citizen science project to map the distribution of Ontario's reptiles and amphibians. Accessed June 23, 2017.
- Ontario Mammal Atlas. Dobbyn, 1995. Accessed July 5, 2017
- Ontario Breeding Bird Atlas. Bird Studies Canada, 2007. Accessed July 5, 2017
- Land Information Ontario, Woodland and Wetland Mapping, 2007.

STUDY AREA

The study area includes the subject area outlined on Figure 1 as well as adjacent lands up to 120 metres surrounding the subject area (Figure 1).

PLANNING CONTEXT

Municipality of Brockton Zoning By-law (2013-26)

The study area is zoned as Environmental Protection under the Municipality of Brockton Zoning By-law (2013-26). Section 24.3 states notwithstanding any other provisions and definitions of this By-law, all buildings and structures shall be prohibited in an 'Environmental Protection (EP)' zone except for the following:

- i. Those necessary for flood and/or erosion control purposes in accordance with Section 24.3
- ii. Unenclosed picnic shelters
- iii. Washroom facilities associated with a Public Park or Conservation Area
- iv. Buildings essential for public services
- v. Boat Launching and Docking

Section 3.5.1 states that nothing in this By-law shall prevent the strengthening to a safe condition of any building or structure or part of any such building or structure which does not comply with the provisions of this By-law, provided such alteration or repair does not increase the height, habitable space, size, or change the use of such building or structure.

Walkerton Community Official Plan

The study area is designated as Environmental Protection under the Walkerton Community Official Plan (2013). Section 3.9.3 states that certain buildings and structures that must be located within the Environmental Protection designation by the nature of their use, such as for flood or erosion control, are permitted.

Section 3.9.4 states replacement of existing buildings or structures damaged by natural causes may be permitted if the hazard risk does not increase from the original condition and provided such replacement does not increase the height, size, volume or change the use. Extensions or enlargements may be subject to the requirements of Section 3.9.6.

Section 3.9.6 states an Environmental Impact Study (EIS) is required for new development proposed within the Environmental Protection designation

County of Bruce Official Plan

According to the County of Bruce Official Plan (2013) Schedule 'A', the study area is within lands designated as Environmental Protection/Hazard.

The County of Bruce OP Section 5.8.3 indicates that Hazard Land Areas include those areas of identified Provincially Significant Wetlands and Environmental Hazard Areas such as flood and erosion susceptibility areas, hazard lands, steep slopes or other physical conditions which are severe enough to cause property damage or potential loss of life if the lands were to be developed.

Section 5.8.4 states that buildings and structures are generally not permitted in Hazard Area Lands. Only those uses which do not impair ecological processes and the environmental features so identified will be permitted.

Section 4.3.3 states that in order to achieve County objectives for the protection of the natural environment, development proponents shall be required to prepare an EIS for any proposal that is:

- i. In, or within 120 metres of, a provincially significant wetland;
- ii. In, or within 60 metres of, a locally significant wetland
- iii. In, or within 120 metres of, the habitat of threatened or endangered species;
- iv. In, or within, 120 metres of, a significant woodland, significant valleyland, significant wildlife habitat, deer wintering areas;
- v. In, or within, 120 metres of, fish habitat
- vi. Within the '100 Metre Buffer Zone' or '2 Year Time of Travel (WHPA-B)' for Wellhead Protection Areas or within a 'Intake Protection Zone 1 (IPZ-1)' or 'Intake Protection Zone 2 (IPZ-2)' for Intake Protection Zones;
- vii. Within known areas of karst topography
- viii. In, or within, 50 metres of Areas of Natural and Scientific Interest (ANSI) Earth Science

Section 5.8.5 states that the replacement or rebuilding of an existing building destroyed by natural means beyond the control of the owner may be permitted providing it does not exceed the size or volume of the original building, is located at the same site, unless an environmentally more acceptable site is available and acceptable to the owner which will not aggravate the existing hazardous situation, and is for substantially the same use, subject to the approval of the local municipality and the appropriate approval authorities.

Saugeen Valley Conservation Authority

The majority of the proposed study area is within the SVCA screening area and contains a portion of the Greenock Swamp Provincially Significant Wetland Complex.

Section 3.7.2.3 of the Environmental Planning and Regulations Policies Manual (2017) states all wetlands and their associated areas of interference are regulated under the *Development, Interference with Wetlands and Alteration to Shorelines and Watercourses Regulation*. Any *development* or *interference* within wetlands or development in areas of interference requires permission from the SVCA.

An EIS to assess the hydrologic impact may be required if the submitted plans do not demonstrate the following:

- Disturbance to natural vegetation communities contributing to the hydrologic function of the wetland are avoided
- Overall existing drainage patterns for the lot will be maintained
- Disturbed area and soil compaction is minimized
- Development is located above the high water table
- All sewage disposal systems are located a minimum of 15 metres from the wetland and a minimum of 0.9 metres above the water table
- Impervious areas are minimized
- Best management practices are used to:
 - Maintain water balance
 - Control sediment and erosion
 - Maintain as much of the wetland buffer as possible.

Section 4.15.1 Interference with Watercourses states watercourse crossings may be permitted if it has been demonstrated to the satisfaction of the SVCA that the interference is acceptable on the natural features and hydrologic and ecological functions of the watercourse. At a minimum, plans should demonstrate the following based on the morphological characteristics of the watercourse:

- i. Culverts have an open bottom where feasible and where it is not feasible, culverts are appropriately embedded into the watercourse;

- ii. Crossing location, width and alignment should be compatible with stream morphology which typically requires location of the crossing on a straight and shallow/riffle reach of the watercourse with the crossing situated at right angles to the watercourse;
- iii. The crossing is sized and located such that there is no increase in upstream or downstream erosion or flooding;
- iv. The design should consider fish and wildlife passage;
- v. Have regard for upstream and downstream effects when installing/replacing a culvert

BACKGROUND REVIEW

Additional background natural heritage information related to the subject lands and adjacent lands identified the following information:

1. The Ontario Reptile and Amphibian Atlas shows within a 10 km square of the subject lands, the recent and historical presence of 13 species of reptiles and amphibians, including one species of Conservation Concern (Snapping Turtle (SC)).
2. The Natural heritage Information Center indicates the presence of 2 species of Conservation Concern within the 1 km square covering the project location (Snapping Turtle (SC) and Bobolink (THR)).
3. The Ontario Mammal Atlas indicates that two species of Conservation Concern, Little Brown Myotis (END) and Northern Myotis (END) may occur within 10km of the study areas.
4. The Ontario Breeding Bird Atlas indicates the presence of 8 species of Conservation Concern within the 10km square covering the project location (Eastern Wood-pewee (SC), Bank Swallow (THR), Barn Swallow (THR), Wood Thrush (SC), Golden-winged Warbler (SC), Grasshopper Sparrow (SC), Bobolink (THR), Eastern Meadowlark (THR)).

Based on a review of the background information and an ortho-photograph review of habitat present in the study area, it is unlikely that any Species at Risk identified in the literature review will occur within the proposed bridge removal or adjacent the study area. As a result, detailed wildlife surveys are not recommended for reptiles or bats, unless candidate habitat is identified in the study area through a review of Significant Wildlife Habitat for the sites.

PROPOSED TERMS OF REFERENCE

Scoped Environmental Impact Study

To fulfill the requirements of this study, we will:

1. Complete an MNRF Request for Information and determine if any Species at Risk have been identified in the study area, and any studies required by the MNRF under the ESA (2007).
2. Conduct a screening of all background information and the site to determine the potential for the presence of Species at Risk (SAR).
3. Field Studies:
 - a. Conduct two site visits to characterize vegetation communities using the ELC system (MNRF) and complete a 2 season botanical inventory
 - b. Evaluate underside of bridge for evidence of Barn Swallow nesting.
 - c. Investigate the study area for habitat that may support important life stages for Species at Risk identified during SAR site screening.
 - d. Investigate the study area for the presence of significant wildlife habitat; and complete a site assessment for all SWH (e.g. bat maternity habitat, raptor wintering areas, amphibian breeding habitat, turtle nesting, habitat for species of conservation concern) using the SWH Criteria schedules for Ecoregion 6E (2015)
 - e. Document all observations of incidental wildlife
4. Species of flora and fauna found during field study or previously recorded as significant locally/regionally, Species at Risk (Endangered Species Act, 2007; Species at Risk Act, 2002) will be reported
5. Record observations of incidental wildlife during all site visits
6. Communications with project team, SVCA, Count and the Municipality as needed.
7. Analyze findings and prepare a map that shows:
 - a. Identified natural heritage features, and functions, and landscape level features (e.g. linkages, forest interior habitat)
 - b. The proposed alternatives
 - c. ELC vegetation communities (two season botanical)
 - d. Any significant observations
 - e. Other noteworthy features as needed
 - f. Locations of other natural heritage features from background literature searches (e.g. mammal atlas, herpetofaunal atlas, County's OP, Township Zoning By-law).
8. Provide policy rationale for expected impacts to natural heritage features (e.g. removal of trees and grading to accommodate development, requirements)
9. Design Review: Conduct an analysis of the design options and provide recommendations as they relate to natural heritage features.
10. Prepare report with appendices and figures as needed of methodology, existing conditions, design alternatives/impacts and mitigation guidelines and recommendations.

Please contact the undersigned should you require additional information of the above.

Yours truly,

ABOUD & ASSOCIATES INC.



Shannon Ferguson, B. Env., Eco. Rest. Cert.

Ecologist

CC. Andrea Nelson, Senior Hydrogeologist, GM BluePlan

John Strader, Roads Superintendent, Municipality of Brockton

Bruce Stickney, Manager of Land Use, Bruce County

S:\A+A Projects\2017\2-Approved Projects\17-119A Greenock Bridge 002 EIS\Approvals, Comments\Terms of Reference\17-119A Terms of Reference DRAFT.docx



LEGEND

- STUDY AREA
- SUBJECT AREA
- WOODLAND
- WETLAND (UNEVALUATED)
- WETLAND (EVALUATED)

Information Sources:
 1. Orthophotography provided by First Base Solutions
 Accessed July 6, 2017.
 2. Wooded Areas provided by Land Information Ontario.
 Accessed July 6, 2017.
 3. Wetlands provided by Land Information Ontario
 Accessed July 6, 2017.

STUDY AREA

Project:
**RIVERSDALE BRIDGE
 (NO. 0002)**



Date: JULY 2017
 Project: AA17-119A
 Scale: 1 : 5000

ABOUT & ASSOCIATES INC.
 Consulting Arborists • Ecologists • Landscape Designers
 881 Woodbine Street, Suite 200, Ontario, Canada M1H 3K5
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Figure No:

1



1078 Bruce Road 12, P.O. Box 150, Formosa ON Canada N0G 1W0
Tel 519-367-3040, Fax 519-367-3041, publicinfo@svca.on.ca, www.svca.on.ca

SENT ELECTRONICALLY ONLY (sferguson@aboudtng.com)

October 11, 2017

Aboud and Associates Inc.
190 Nicklin Road
Guelph, Ontario
N1H 7L5

ATTN: Shannon Ferguson, Ecologist

Dear Ms. Ferguson,

RE: Bridge No. 0002
Bridge Street, Riversdale
Lot 30, Con 1NDR
Geographic Township of Greenock
Municipality of Brockton

It is the understanding of the Saugeen Valley Conservation Authority (SVCA) that Aboud and Associates has been awarded a sub-consultant contract from GM Blue Plan to assess the agency requirements and provide a scoped Environmental Impact Study (EIS) for the bridge replacement at the above-mentioned location in the Geographic Township of Greenock. You have since provided Terms of Reference (ToR) for Bridge No. 0002 for SVCA review.

SVCA offers the following comments based on the information that was provided for the replacement of the pony truss bridge at the above noted location. These comments are based on our general examination of the site, existing file information and aerial photographs.

Please be advised that this bridge is subject to SVCA's Development, Interference with Wetlands and Alterations to Shorelines and Watercourses Regulation (Ontario Regulation 169/06, as amended). This Regulation is in accordance with Section 28 of the *Conservation Authorities Act*, R.S.O. 1990, Chap. C. 27 and requires that a person obtain the written permission of the SVCA prior to any "development" in a Regulated Area or alteration to a wetland or watercourse.

"Development" and "Alteration"

Subsection 28 (25) of the Conservation Authorities Act defines development as:

- a) the construction, reconstruction, erection or placing of a building or structure of any kind,*
- b) any change to a building or structure that would have the effect of altering the use or potential use of the building or structure, increasing the size of the building or structure or increasing the number of dwelling units in the building or structure;*



Watershed Member Municipalities

Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands, Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce, Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North, Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

- c) site grading; or,*
- d) the temporary or permanent placing, dumping or removal of any material, originating on the site or elsewhere.*

According to Section 5 of Ontario Regulation 169/06, as amended, alteration generally includes the straightening, diverting or interference in any way with the existing channel of a river, creek, stream or watercourse, or the changing or interfering in any way with a wetland.

The SVCA has not received plans for the new bridge design and will require such plans to comment specifically, however SVCA staff understands that the bridge will be replaced with a similar single-lane structure with the same span between the abutments or perhaps be realigned.

SVCA Policy Manual

Policy 4.15.1-1

Public infrastructure is an activity approved through a satisfactory EA process and other studies deemed necessary by the SVCA.

If the replacement bridge will not change the constriction of the river flow at this location, the SVCA will have no objection to the proposed project. If the bridge design conforms with the existing parameters of the existing bridge, and the hydrology will not be altered, SVCA staff will not require a Hydrologic Assessment for review. Additionally, SVCA staff will not require an EIS for review for this replacement. If the plans for the bridge change from what is existing or further restrict flow, an Engineered Hydrology Report for both the Teeswater River and Greenock Creek including a back-water analysis will need to be provided for SVCA review. If any changes to this bridge or to the approaches or road realignment will occur, an EIS is likely required for this project.

Department of Fisheries and Oceans

In the past, Conservation Authorities served as the first point of contact and the local service provider for review of Section 35 of the previous version of the Fisheries Act, and had entered into agreements with Fisheries and Oceans Canada to facilitate this process. Changes to the Fisheries Act effective November 25, 2013, have resulted in the cancellation of these agreements. It is now the responsibility of the proponent to contact the Department of Fisheries and Oceans at 1-855-852-8320 or <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html> to ensure their project addresses the Fisheries Act.

Limitation of SVCA Comments

The SVCA has provided comments based on the information that is currently available. Should construction not proceed for some time, there is no guarantee the SVCA comments will remain unchanged indefinitely.

An application to Alter a Regulated Area and the related fee of \$715.00 (Standard Works Application Fee to Alter a Watercourse) should be included with the design plans when they are prepared. Thank you for your cooperation. Should you have any questions, please do not hesitate to contact Michelle Gallant of this office.

Sincerely,

A handwritten signature in blue ink, reading "Michelle Gallant". The signature is fluid and cursive, with the first name "Michelle" and last name "Gallant" clearly legible.

Michelle Gallant
Regulations Officer
Saugeen Valley Conservation Authority

MG/

cc: Dan Gieruszak, Authority Member, SVCA (via e-mail)
Andrea Nelson, M.SC. Senior Hydrogeologist (via e-mail)

APPENDIX 2
Background Wildlife List

| DATE OBS | COMMON NAME | SCIENTIFIC NAME | SARO | COSEWIC | SARA | S-RANK | G-RANK | COSEWIC_DATE | AREA SENSITIVE | AREA REQUIRED | PIF SPECIES (BCR 13) | COMMENTS |
|-------------|------------------------|------------------------------|------|---------|------|---------|--------|--------------|----------------|---------------|----------------------|----------|
| | AMPHIBIANS | | | | | | | | | | | |
| ORAA (2013) | Spotted Salamander | Ambystoma maculatum | | | | S4 | G5 | | | | | |
| ORAA (1996) | American Toad | Anaxyrus americanus | | | | S5 | G5 | | | | | |
| ORAA (1989) | Gray Treefrog | Hyla versicolor | | | | S5 | G5 | | | | | |
| ORAA (1996) | Spring Peeper | Pseudacris crucifer | | | | S5 | G5 | | | | | |
| ORAA (1981) | American Bullfrog | Lithobates catesbeianus | | | | S4 | G5 | | ✓ | | | |
| ORAA (1989) | Green Frog | Lithobates clamitans | | | | S5 | G5 | | | | | |
| ORAA (1996) | Northern Leopard Frog | Lithobates pipiens | NAR | NAR | | S5 | G5 | 17/10/2005 | | | | |
| ORAA (2013) | Wood Frog | Lithobates sylvaticus | | | | S5 | G5 | | | | | |
| | | | | | | | | | | | | |
| | SNAKES AND LIZARDS | | | | | | | | | | | |
| ORAA (1981) | Northern Watersnake | Nerodia sipedon sipedon | NAR | NAR | | S5 | G5T5 | 17/10/2005 | | | | |
| ORAA (1989) | Eastern Gartersnake | Thamnophis sirtalis sirtalis | | | | S5 | G5T5 | | | | | |
| | | | | | | | | | | | | |
| | TURTLES | | | | | | | | | | | |
| ORAA (2016) | Snapping Turtle | Chelydra serpentina | SC | SC | SC | S3 | G5T5 | 30/11/2008 | | | | |
| ORAA (1988) | Midland Painted Turtle | Chrysemys picta marginata | | | | S5 | G5T5 | | | | | |
| | | | | | | | | | | | | |
| | BIRDS | | | | | | | | | | | |
| OBBA (2007) | Green Heron | Butorides virescens | | | | S4B | G5 | | | | | |
| OBBA (2007) | Canada Goose | Branta canadensis | | | | S5 | G5 | | | | | |
| OBBA (2007) | Wood Duck | Aix sponsa | | | | S5 | G5 | | | | | |
| OBBA (2007) | American Black Duck | Anas rubripes | | | | S4 | G5 | | | | | |
| OBBA (2007) | Mallard | Anas platyrhynchos | | | | S5 | G5 | | | | | |
| OBBA (2007) | Hooded Merganser | Lophodytes cucullatus | | | | S5B,S5N | G5 | | | | | |
| OBBA (2007) | Turkey Vulture | Cathartes aura | | | | S5B | G5 | | | | | |
| OBBA (2007) | Northern Harrier | Circus cyaneus | NAR | NAR | | S4B | G5 | 17/10/2005 | ✓ | >30ha | ✓ | |
| OBBA (2007) | Sharp-shinned Hawk | Accipiter striatus | NAR | | | S5 | G5 | | ✓ | >30ha | | |
| OBBA (2007) | Red-tailed Hawk | Buteo jamaicensis | NAR | NAR | | S5 | G5 | 17/10/2005 | | | | |
| OBBA (2007) | American Kestrel | Falco sparverius | | | | S4 | G5 | | | | ✓ | |
| OBBA (2007) | Ruffed Grouse | Bonasa umbellus | | | | S4 | G5 | | | | | |

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Project #: AA17-119

| | | | | | | | | | | | | |
|-------------|-------------------------------|----------------------------|-----|-----|-----|---------|----|------------|---|--------|---|--|
| OBBA (2007) | Wild Turkey | Meleagris gallopavo | | | | S5 | G5 | | | | | |
| OBBA (2007) | Killdeer | Charadrius vociferus | | | | S5B,S5N | G5 | | | | | |
| OBBA (2007) | Wilson's Snipe | Gallinago delicata | | | | S5B | G5 | | | | | |
| OBBA (2007) | American Woodcock | Scolopax minor | | | | S4B | G5 | | | | | |
| OBBA (2007) | Rock Pigeon | Columba livia | | | | SNA | G5 | | | | | |
| OBBA (2007) | Mourning Dove | Zenaida macroura | | | | S5 | G5 | | | | | |
| OBBA (2007) | Black-billed Cuckoo | Coccyzus erythrophthalmus | | | | S5B | G5 | | | | ✓ | |
| OBBA (2007) | Yellow-billed Cuckoo | Coccyzus americanus | | | | S4B | G5 | | | | | |
| OBBA (2007) | Eastern Screech-Owl | Megascops asio | NAR | NAR | | S4 | G5 | 17/10/2005 | | | | |
| OBBA (2007) | Barred Owl | Strix varia | | | | S5 | G5 | | ✓ | >100ha | | |
| OBBA (2007) | Ruby-throated Hummingbird | Archilochus colubris | | | | S5B | G5 | | | | | |
| OBBA (2007) | Belted Kingfisher | Megaceryle alcyon | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Red-headed Woodpecker | Melanerpes erythrocephalus | SC | THR | THR | S4B | G5 | 28/04/2007 | | | ✓ | |
| OBBA (2007) | Yellow-bellied Sapsucker | Sphyrapicus varius | | | | S5B | G5 | | ✓ | 2-5ha | | |
| OBBA (2007) | Downy Woodpecker | Picoides pubescens | | | | S5 | G5 | | | | | |
| OBBA (2007) | Hairy Woodpecker | Picoides villosus | | | | S5 | G5 | | ✓ | 4-8ha | | |
| OBBA (2007) | Northern Flicker | Colaptes auratus | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Eastern Wood-pewee | Contopus virens | SC | SC | | S4B | G5 | 27/06/2014 | | | ✓ | |
| OBBA (2007) | Alder Flycatcher | Empidonax alnorum | | | | S5B | G5 | | | | | |
| OBBA (2007) | Willow Flycatcher | Empidonax traillii | | | | S5B | G5 | | | | ✓ | |
| OBBA (2007) | Least Flycatcher | Empidonax minimus | | | | S4B | G5 | | ✓ | >100ha | | |
| OBBA (2007) | Eastern Phoebe | Sayornis phoebe | | | | S5B | G5 | | | | | |
| OBBA (2007) | Great Crested Flycatcher | Myiarchus crinitus | | | | S4B | G5 | | | | | |
| OBBA (2007) | Eastern Kingbird | Tyrannus tyrannus | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Horned Lark | Eremophila alpestris | | | | S5B | G5 | | | | | |
| OBBA (2007) | Tree Swallow | Tachycineta bicolor | | | | S4B | G5 | | | | | |
| OBBA (2007) | Northern Rough-winged Swallow | Stelgidopteryx serripennis | | | | S4B | G5 | | | | | |
| OBBA (2007) | Bank Swallow | Riparia riparia | THR | THR | | S4B | G5 | 27/06/2014 | | | ✓ | |
| OBBA (2007) | Cliff Swallow | Petrochelidon pyrrhonota | | | | S4B | G5 | | | | | |
| OBBA (2007) | Barn Swallow | Hirundo rustica | THR | THR | | S4B | G5 | 09/05/2011 | | | | |
| OBBA (2007) | Blue Jay | Cyanocitta cristata | | | | S5 | G5 | | | | | |
| OBBA (2007) | American Crow | Corvus brachyrhynchos | | | | S5B | G5 | | | | | |
| OBBA (2007) | Common Raven | Corvus corax | | | | S5 | G5 | | | | | |
| OBBA (2007) | Black-capped Chickadee | Poecile atricapillus | | | | S5 | G5 | | | | | |
| OBBA (2007) | White-breasted Nuthatch | Sitta carolinensis | | | | S5 | G5 | | ✓ | >10ha | | |
| OBBA (2007) | Brown Creeper | Certhia americana | | | | S5B | G5 | | ✓ | >30ha | | |
| OBBA (2007) | House Wren | Troglodytes aedon | | | | S5B | G5 | | | | | |
| OBBA (2007) | Eastern Bluebird | Sialia sialis | NAR | NAR | | S5B | G5 | 17/10/2005 | | | | |

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Project #: AA17-119

| | | | | | | | | | | | | |
|-------------|------------------------------|---------------------------|-----|-----|-----|-----|------|------------|---|--------|---|--|
| OBBA (2007) | Veery | Catharus fuscescens | | | | S4B | G5 | | ✓ | >10ha | | |
| OBBA (2007) | Wood Thrush | Hylocichla mustelina | SC | THR | | S4B | G5 | 27/06/2014 | | | ✓ | |
| OBBA (2007) | American Robin | Turdus migratorius | | | | S5B | G5 | | | | | |
| OBBA (2007) | Gray Catbird | Dumetella carolinensis | | | | S4B | G5 | | | | | |
| OBBA (2007) | Cedar Waxwing | Bombycilla cedrorum | | | | S5B | G5 | | | | | |
| OBBA (2007) | European Starling | Sturnus vulgaris | | | | SNA | G5 | | | | | |
| OBBA (2007) | Yellow-throated Vireo | Vireo flavifrons | | | | S4B | G5 | | ✓ | >30ha | | |
| OBBA (2007) | Warbling Vireo | Vireo gilvus | | | | S5B | G5 | | | | | |
| OBBA (2007) | Red-eyed Vireo | Vireo olivaceus | | | | S5B | G5 | | | | | |
| OBBA (2007) | Blue-winged Warbler | Vermivora pinus | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Golden-winged Warbler | Vermivora chrysoptera | SC | THR | THR | S4B | G4 | 01/04/2006 | | | ✓ | |
| OBBA (2007) | Yellow Warbler | Dendroica petechia | | | | S5B | G5 | | | | | |
| OBBA (2007) | Chestnut-sided Warbler | Dendroica pensylvanica | | | | S5B | G5 | | | | | |
| OBBA (2007) | Black-throated Green Warbler | Dendroica virens | | | | S5B | G5 | | ✓ | >30ha | | |
| OBBA (2007) | Black-and-white Warbler | Mniotilta varia | | | | S5B | G5 | | ✓ | >100ha | | |
| OBBA (2007) | American Redstart | Setophaga ruticilla | | | | S5B | G5 | | ✓ | >100ha | | |
| OBBA (2007) | Ovenbird | Seiurus aurocapilla | | | | S4B | G5 | | ✓ | >70ha | | |
| OBBA (2007) | Northern Waterthrush | Seiurus noveboracensis | | | | S5B | G5 | | | | | |
| OBBA (2007) | Mourning Warbler | Oporornis philadelphia | | | | S4B | G5 | | | | | |
| OBBA (2007) | Common Yellowthroat | Geothlypis trichas | | | | S5B | G5 | | | | | |
| OBBA (2007) | Scarlet Tanager | Piranga olivacea | | | | S4B | G5 | | ✓ | >20ha | | |
| OBBA (2007) | Northern Cardinal | Cardinalis cardinalis | | | | S5 | G5 | | | | | |
| OBBA (2007) | Rose-breasted Grosbeak | Pheucticus ludovicianus | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Indigo Bunting | Passerina cyanea | | | | S4B | G5 | | | | | |
| OBBA (2007) | Chipping Sparrow | Spizella passerina | | | | S5B | G5 | | | | | |
| OBBA (2007) | Field Sparrow | Spizella pusilla | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Vesper Sparrow | Poocetes gramineus | | | | S4B | G5 | | | | ✓ | |
| OBBA (2007) | Savannah Sparrow | Passerculus sandwichensis | | | | S4B | G5 | | ✓ | >50ha | ✓ | |
| OBBA (2007) | Grasshopper Sparrow | Ammodramus savannarum | SC | SC | | S4B | G5TU | | ✓ | >10ha | ✓ | |
| OBBA (2007) | Song Sparrow | Melospiza melodia | | | | S5B | G5 | | | | | |
| OBBA (2007) | Swamp Sparrow | Melospiza georgiana | | | | S5B | G5 | | | | | |
| OBBA (2007) | White-throated Sparrow | Zonotrichia albicollis | | | | S5B | G5 | | | | | |
| OBBA (2007) | Bobolink | Dolichonyx oryzivorus | THR | THR | | S4B | G5 | 01/04/2010 | ✓ | >10ha | ✓ | |
| OBBA (2007) | Red-winged Blackbird | Agelaius phoeniceus | | | | S4 | G5 | | | | | |
| OBBA (2007) | Eastern Meadowlark | Sturnella magna | THR | THR | | S4B | G5 | 09/05/2011 | ✓ | >10ha | ✓ | |
| OBBA (2007) | Common Grackle | Quiscalus quiscula | | | | S5B | G5 | | | | | |
| OBBA (2007) | Brown-headed Cowbird | Molothrus ater | | | | S4B | G5 | | | | | |
| OBBA (2007) | Baltimore Oriole | Icterus galbula | | | | S4B | G5 | | | | ✓ | |

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Project #: AA17-119

| | | | | | | | | | | | | |
|-------------|-----------------------|-------------------------|-----|-----|-----|-----|------|------------|--|--|--|--|
| OBBA (2007) | Purple Finch | Carpodacus purpureus | | | | S4B | G5 | | | | | |
| OBBA (2007) | House Finch | Carpodacus mexicanus | | | | SNA | G5 | | | | | |
| OBBA (2007) | American Goldfinch | Carduelis tristis | | | | S5B | G5 | | | | | |
| OBBA (2007) | House Sparrow | Passer domesticus | | | | SNA | G5 | | | | | |
| | | | | | | | | | | | | |
| | MAMMALS | | | | | | | | | | | |
| OMA (1994) | Little Brown Myotis | Myotis lucifugus | END | END | END | S4 | G3G4 | 03/02/2012 | | | | |
| OMA (1994) | Big Brown Bat | Eptesicus fuscus | | | | S5 | G5 | | | | | |
| OMA (1994) | Eastern Red Bat | Lasiurus borealis | | | | S4 | G4 | | | | | |
| OMA (1994) | Eastern Cottontail | Sylvilagus floridanus | | | | S5 | G5 | | | | | |
| OMA (1994) | Eastern Gray Squirrel | Sciurus carolinensis | | | | S5 | G5 | | | | | |
| OMA (1994) | Red Squirrel | Tamiasciurus hudsonicus | | | | S5 | G5 | | | | | |
| OMA (1994) | Beaver | Castor canadensis | | | | S5 | G5 | | | | | |
| OMA (1994) | Muskrat | Ondatra zibethicus | | | | S5 | G5 | | | | | |
| OMA (1994) | Porcupine | Erethizon dorsatum | | | | S5 | G5 | | | | | |
| OMA (1994) | Red Fox | Vulpes vulpes | | | | S5 | G5 | | | | | |
| OMA (1994) | Northern Raccoon | Procyon lotor | | | | S5 | G5 | | | | | |
| OMA (1994) | American Mink | Mustela vison | | | | S4 | G5 | | | | | |
| OMA (1994) | Striped Skunk | Mephitis mephitis | | | | S5 | G5 | | | | | |
| OMA (1994) | White-tailed Deer | Odocoileus virginianus | | | | S5 | G5 | | | | | |

Legend:

COSARO: Committee on Species at Risk Ontario

COSEWIC: Committee on the status of endangered wildlife in Canada

SARA: Species at Risk Act

ESA: Endangered Species Act

END: Endangered

THR: Threatened

SC: special Concern

NAR: Not At Risk

NL: Not listed

DD: Data Deficient

S-Rank:

S1: Critically Imperiled

S2: Imperiled

S3: Vulnerable

S4: Apparently Secure

S5: Secure

SX: Presumed extirpated

SH: Possibly Extirpated (Historical)

SNR: Unranked

SU: Unrankable— lack of information

SNA: Not applicable— not a suitable target for conservation activities

S#S#: Range Rank— (e.g., S2S3) indicates any range of uncertainty about the status

S#B- Breeding status rank

S#N- Non Breeding status rank

?: Indicates uncertainty in the assigned rank

G-Rank:

G1: Extremely rare globally

G1G2: Extremely rare to very rare globally

G2: Very rare globally

G2G3: Very rare to uncommon globally

G3: Rare to uncommon globally

G3G4: Rare to common globally

G4: Common globally

G4G5: Common to very common globally

G5: Very common globally; demonstrably secure

T: Denotes that the rank applies to a subspecies or variety

Source codes

OBAO: Ontario butterfly Atlas Online

ORAA: Ontario Reptile and Amphibian Atlas

OMA: Ontario Mammal Atlas

OBBA: Ontario Breeding Bird Atlas

References:

Ontario Partners in Flight (PIF). 2008. Ontario Landbird Conservation Plan: Lower Great Lakes/St. Lawrence Plain (North American Bird Conservation Region 13), Priorities, Objectives and Recommended Actions. Environment Canada (Ontario Region) and Ontario Ministry of Natural Resources. Final Draft, November, 2008.

COSSARO Status Endangered Species Act, 2007 (Bill 184). Schedules 1- 5. June 30 2008.

COSEWIC Status COSEWIC. 2014. Canadian Species at Risk. Committee on the Status of Endangered Wildlife in Canada.

Endangered Species Act, 2007 (Bill 184). Schedules 1- 5. April 21, 2015

APPENDIX 3
Ecological Land Classification

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

Project: Bridge No. 0002 Project #: 17-119 Observer(s): SF

Weather conditions:

Date: 07 / 28 / 2017

| | | | | |
|-----------|-------|-------------|---------------|----------------------|
| Temp (°C) | Wind* | Cloud Cover | Precipitation | Precipitation(24hrs) |
| 19 | 2 | 80 | None | None |

*Beaufort Scale: 0- (0 km/hr), 1- (1-5km/hr), 2- (6-11km/hr), 3- (12-19km/hr), 4- (20-28km/hr), 5- (29-38km/hr), 6- (39-49km/hr)

| | | | | |
|--|---|---|--|--|
| Polygon: A | Polygon UTM E: 473056.84 N: 4882273.07 | Community Series SWDM- Deciduous Swamp | Ecosite SWDM 3- Maple Mineral Deciduous Swamp | Vegetation Type |
| System Terrestrial <input type="checkbox"/> Wetland Aquatic | Topographic Feature Lacustrine <input type="checkbox"/> Riverine <input type="checkbox"/> Bottomland Terrace Valley slope Tableland Rolling upland Cliff Talus Crevice Cave Alvar Rockland Beach Bar Sand dune Bluff | | | Dominant Plant Form Plankton Submerged <input type="checkbox"/> Floating-lvd. <input type="checkbox"/> Graminoid Forb Lichen Bryophyte <input type="checkbox"/> Deciduous <input type="checkbox"/> Coniferous Mixed |
| Cover Open <input type="checkbox"/> Shrub <input type="checkbox"/> <input type="checkbox"/> Treed | History <input type="checkbox"/> Natural <input type="checkbox"/> Cultural | Community Class Beach-Bar Sand Dune Bluff Cliff Talus Alvar <input type="checkbox"/> Rock Barren <input type="checkbox"/> Crevice-Cave Sand Barren Meadow Tallgrass Prairie Savannah Woodland Forest Thicket Cultural <input type="checkbox"/> Swamp <input type="checkbox"/> Fen Bog Marsh Open Water Shallow Water | | |
| Stand Description: | | Soil Analysis: | | |
| Community Age Pioneer Young Mid-Aged Mature Old Growth | | Basal Area (m²/ha) | Soil Drainage Very Rapid Rapid Well Moderately Well Imperfect Poor Very Poor | |
| Standing Snags Rare Occasional Abundant Dominant | | Soil Moisture Regime Dry Fresh Moist Wet | | |
| Deadfall Logs Rare Occasional Abundant Dominant | | Effective Soil Texture | | |
| Healt Low Medium High | Sensitivity Low Medium High | Botanical Quality Low Medium High | Depth to Mottles / Gley Sample: M - -- cm / G - -- cm | |
| Slope none gentle moderate steep (simple or complex) | | Depth to Groundwater metres at surface less than 1m more than 1 m | | Depth to Bedrock metres at surface less than 1m more than 1 m |

| Vegetation Layer | Height ¹ | Cover ² | Dominant Species per Vegetation Layer |
|------------------|---------------------|--------------------|---------------------------------------|
| 1 Canopy | 1 | 4 | ACESASA >> FRAPENN > ULMAMER |
| 2 Subcanopy | 2 | 3 | ACESASA > FRAPENN > ULMAMER > THUOCCI |
| 3 Understorey | 3 | 2 | FRAPENN > CORSTOL > ACENEGU > JUGNIGR |
| 4 Ground Layer | 6 | 4 | BOECYLI > PHAARUN > VITRIPA > SIUSUAV |

¹ Height Code: 1=>20m, 2=10m-20m, 3=2m-10m, 4=1m-2m, 5=0.5m-1m, 6=0.2m-0.5m, 7= < 0.2m ² Cover Codes: 0 = none, 1 = 0% - 10%, 2 = 10% - 25%, 3 = 25% - 60%, 4 = >60%

| Size Class Analysis ³ | < 10 cm DBH | 10 to 24 cm DBH | 25 to 50 cm DBH | > 50 cm DBH |
|--|-------------|-----------------|-----------------|-------------|
| ³ Abundance Code: RS=Rare, O=Occasional, A=Abundant, D=Dominant | | | | |

Evidence of Disturbance:
Litter on east side of the river

Wildlife / Habitat Observations / Comments:
MODO, AMCR

| Community Name | | | | Code | % Coverage |
|----------------|--|---------|--|------|------------|
| Inclusion | | Complex | | | |
| Inclusion | | Complex | | | |
| Inclusion | | Complex | | | |

[illegible][illegible]

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

Project: **Bridge No. 0002** Project #: **17-119** Observer(s): **SF**

Weather conditions:

Date: **07 / 28 / 2017**

| Temp (°C) | Wind* | Cloud Cover | Precipitation | Precipitation(24hrs) |
|-----------|-------|-------------|---------------|----------------------|
| 19 | 2 | 80 | None | None |

*Beaufort Scale: 0- (0 km/hr), 1- (1-5km/hr), 2- (6-11km/hr), 3- (12-19km/hr), 4- (20-28km/hr), 5- (29-38km/hr), 6- (39-49km/hr)

| | | | | |
|---|---|---|---|---|
| Polygon: B | Polygon UTM E: 473223.66 N: 4881798.11 | Community Series SWD- Deciduous Swamp | Ecosite SWDO 2- Maple Organic Deciduous Swamp Ecosite | Vegetation Type |
| System Terrestrial <input type="checkbox"/> Wetland Aquatic | Topographic Feature Lacustrine <input type="checkbox"/> Riverine <input type="checkbox"/> Bottomland <input type="checkbox"/> Terrace <input type="checkbox"/> Valley slope <input type="checkbox"/> Tableland <input type="checkbox"/> Rolling upland <input type="checkbox"/> Cliff <input type="checkbox"/> Talus <input type="checkbox"/> Crevice <input type="checkbox"/> Cave <input type="checkbox"/> Alvar <input type="checkbox"/> Rockland <input type="checkbox"/> Beach <input type="checkbox"/> Bar <input type="checkbox"/> Sand dune <input type="checkbox"/> Bluff | | | Dominant Plant Form Plankton <input type="checkbox"/> Submerged <input type="checkbox"/> Floating-lvd. <input type="checkbox"/> Graminoid <input type="checkbox"/> Forb <input type="checkbox"/> Lichen <input type="checkbox"/> Bryophyte <input type="checkbox"/> <input type="checkbox"/> Deciduous <input type="checkbox"/> Coniferous <input type="checkbox"/> Mixed <input type="checkbox"/> |
| Cover Open <input type="checkbox"/> Shrub <input type="checkbox"/> <input type="checkbox"/> Treed | History Natural <input type="checkbox"/> Cultural <input type="checkbox"/> | Community Class Beach-Bar <input type="checkbox"/> Sand Dune <input type="checkbox"/> Bluff <input type="checkbox"/> Cliff <input type="checkbox"/> Talus <input type="checkbox"/> Alvar <input type="checkbox"/> Rock Barren <input type="checkbox"/> Crevice-Cave <input type="checkbox"/> Sand Barren <input type="checkbox"/> Meadow <input type="checkbox"/> Tallgrass <input type="checkbox"/> Prairie <input type="checkbox"/> Savannah <input type="checkbox"/> Woodland <input type="checkbox"/> Forest <input type="checkbox"/> Thicket <input type="checkbox"/> Cultural <input type="checkbox"/> <input type="checkbox"/> Swamp <input type="checkbox"/> Fen <input type="checkbox"/> Bog <input type="checkbox"/> Marsh <input type="checkbox"/> Open Water <input type="checkbox"/> Shallow Water <input type="checkbox"/> | | |
| Stand Description: | | Soil Analysis: | | |
| Community Age Pioneer <input type="checkbox"/> Young <input type="checkbox"/> Mid-Aged <input type="checkbox"/> Mature <input type="checkbox"/> Old Growth <input type="checkbox"/> | | Basal Area (m²/ha) | Soil Drainage Very Rapid <input type="checkbox"/> Rapid <input type="checkbox"/> Well <input type="checkbox"/> Moderately Well <input type="checkbox"/> Imperfect <input type="checkbox"/> Poor <input type="checkbox"/> Very Poor <input type="checkbox"/> | |
| Standing Snags Rare <input type="checkbox"/> Occasional <input type="checkbox"/> Abundant <input type="checkbox"/> Dominant <input type="checkbox"/> | | Soil Moisture Regime Dry <input type="checkbox"/> Fresh <input type="checkbox"/> Moist <input type="checkbox"/> Wet <input type="checkbox"/> | | |
| Deadfall Logs Rare <input type="checkbox"/> Occasional <input type="checkbox"/> Abundant <input type="checkbox"/> Dominant <input type="checkbox"/> | | Effective Soil Texture | | |
| Healt Low <input type="checkbox"/> Medium <input type="checkbox"/> High <input type="checkbox"/> | Sensitivity Low <input type="checkbox"/> Medium <input type="checkbox"/> High <input type="checkbox"/> | Botanical Quality Low <input type="checkbox"/> Medium <input type="checkbox"/> High <input type="checkbox"/> | Depth to Mottles / Gley Sample: M - -- cm / G - -- cm | |
| Slope none <input type="checkbox"/> gentle <input type="checkbox"/> moderate <input type="checkbox"/> steep (simple or complex) <input type="checkbox"/> | | Depth to Groundwater at surface <input type="checkbox"/> less than 1m <input type="checkbox"/> more than 1 m <input type="checkbox"/> | metres | Depth to Bedrock at surface <input type="checkbox"/> less than 1m <input type="checkbox"/> more than 1 m <input type="checkbox"/> |
| metres | | | | |

| Vegetation Layer | Height ¹ | Cover ² | Dominant Species per Vegetation Layer |
|------------------|---------------------|--------------------|---|
| 1 Canopy | 1 | 4 | ACESASA >> ULMAMER |
| 2 Subcanopy | 2 | 3 | ACESASA > ULMAMER > ACENEGU |
| 3 Understorey | 3 | 3 | ACENEGU = POPTREM |
| 4 Ground Layer | 6 | 3 | ONOSENS > PHAARUN > GRASS SP. > BOECYLI |

¹ Height Code: 1=>20m, 2=10m-20m, 3=2m-10m, 4=1m-2m, 5=0.5m-1m, 6=0.2m-0.5m, 7=< 0.2m ² Cover Codes: 0 = none, 1 = 0%- 10%, 2 = 10%- 25%, 3 = 25%-60%, 4 = >60%

| Size Class Analysis ³ | < 10 cm DBH | 10 to 24 cm DBH | 25 to 50 cm DBH | > 50 cm DBH |
|--|-------------|-----------------|-----------------|-------------|
| ³ Abundance Code: RS=Rare, O=Occasional, A=Abundant, D=Dominant | | | | |

| |
|--|
| Evidence of Disturbance: |
| Wildlife / Habitat Observations / Comments: |

| Inclusion | Complex | Community Name | Code | % Coverage |
|-----------|---------|----------------|------|------------|
| Inclusion | Complex | | | |
| Inclusion | Complex | | | |
| Inclusion | Complex | | | |

[illegible][illegible]

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

Project: **Bridge No. 0002** Project #: **17-119** Observer(s): **SF**

Weather conditions:

Date: **07/28/2017**

| | | | | |
|-----------|-------|-------------|---------------|----------------------|
| Temp (°C) | Wind* | Cloud Cover | Precipitation | Precipitation(24hrs) |
| 19 | 2 | 80 | None | None |

*Beaufort Scale: 0- (0 km/hr), 1- (1-5km/hr), 2- (6-11km/hr), 3- (12-19km/hr), 4- (20-28km/hr), 5- (29-38km/hr), 6- (39-49km/hr)

| | | | | |
|--|---|---|--|--|
| Polygon: C | Polygon UTM E: 473338.77 N: 4881815.75 | Community Series MEGM- Graminoid Meadow | Ecosite MEGM 3- Dry- Fresh Graminoid Meadow | Vegetation Type |
| System Terrestrial Wetland Aquatic | Topographic Feature Lacustrine Riverine Bottomland Terrace Valley slope Tableland Rolling upland Cliff Talus Crevice Cave Alvar Rockland Beach Bar Sand dune Bluff | | | Dominant Plant Form Plankton Submerged Floating-lvd. Graminoid Forb Lichen Bryophyte Deciduous Coniferous Mixed |
| Cover Open Shrub Treed | History Natural Cultural | Community Class Beach-Bar Sand Dune Bluff Cliff Talus Alvar Rock Barren Crevice-Cave Sand Barren Meadow Tallgrass Prairie Savannah Woodland Forest Thicket Cultural Swamp Fen Bog Marsh Open Water Shallow Water | | |
| Stand Description: | | Soil Analysis: | | |
| Community Age Pioneer Young Mid-Aged Mature Old Growth | | Basal Area (m²/ha) | Soil Drainage Very Rapid Rapid Well Moderately Well Imperfect Poor Very Poor | |
| Standing Snags Rare Occasional Abundant Dominant | | Soil Moisture Regime Dry Fresh Moist Wet | | |
| Deadfall Logs Rare Occasional Abundant Dominant | | Effective Soil Texture | | |
| Healt Low Medium High | Sensitivity Low Medium High | Botanical Quality Low Medium High | Depth to Mottles / Gley Sample: M - -- cm / G - -- cm | |
| Slope none gentle moderate steep (simple or complex) | | Depth to Groundwater metres at surface less than 1m more than 1 m | | Depth to Bedrock metres at surface less than 1m more than 1 m |

| Vegetation Layer | Height ¹ | Cover ² | Dominant Species per Vegetation Layer |
|------------------|---------------------|--------------------|---|
| 1 Canopy | | | |
| 2 Subcanopy | | | |
| 3 Understorey | 3 | 2 | RUBUS SP. > FRAPENN > POPTREM |
| 4 Ground Layer | 6 | 4 | GRASS SP. >> SOLIDAGO SP. > PHAARUN > DAUCARO |

¹ Height Code: 1=>20m, 2=10m-20m, 3=2m-10m, 4=1m-2m, 5=0.5m-1m, 6=0.2m-0.5m, 7= < 0.2m ² Cover Codes: 0 = none, 1 = 0%- 10%, 2 = 10%- 25%, 3 = 25%-60%, 4= >60%

| Size Class Analysis ³ | < 10 cm DBH | 10 to 24 cm DBH | 25 to 50 cm DBH | > 50 cm DBH |
|--|-------------|-----------------|-----------------|-------------|
| ³ Abundance Code: RS=Rare, O=Occasional, A=Abundant, D=Dominant | | | | |

Evidence of Disturbance:

Wildlife / Habitat Observations / Comments:

EAGA (on road shoulder)

| Community Name | | | | Code | % Coverage |
|----------------|--|---------|--|------|------------|
| Inclusion | | Complex | | | |
| Inclusion | | Complex | | | |
| Inclusion | | Complex | | | |

[illegible][illegible]

ELC COMMUNITY DESCRIPTION & CLASSIFICATION

Project: Bridge No. 0002 Project #: 17-119 Observer(s): SF

Weather conditions:

Date: 07/28/2017

| | | | | |
|-----------|-------|-------------|---------------|----------------------|
| Temp (°C) | Wind* | Cloud Cover | Precipitation | Precipitation(24hrs) |
| 19 | 2 | 80 | None | None |

*Beaufort Scale: 0- (0 km/hr), 1- (1-5km/hr), 2- (6-11km/hr), 3- (12-19km/hr), 4- (20-28km/hr), 5- (29-38km/hr), 6- (39-49km/hr)

| | | | | |
|--|---|---|--|--|
| Polygon: D | Polygon UTM E:473058.49 N: 4881774.24 | Community Series WOD- Deciduous Woodland | Ecosite WODM 4- Dry- Fresh Deciduous Woodland | Vegetation Type |
| System Terrestrial Wetland Aquatic | Topographic Feature Lacustrine Riverine Bottomland Terrace Valley slope Tableland Rolling upland Cliff Talus Crevice Cave Alvar Rockland Beach Bar Sand dune Bluff | | | Dominant Plant Form Plankton Submerged Floating-lvd. Graminoid Forb Lichen Bryophyte Deciduous Coniferous Mixed |
| Cover Open Shrub Treed | History Natural Cultural | Community Class Beach-Bar Sand Dune Bluff Cliff Talus Alvar Rock Barren Crevice-Cave Sand Barren Meadow Tallgrass Prairie Savannah Woodland Forest Thicket Cultural Swamp Fen Bog Marsh Open Water Shallow Water | | |
| Stand Description: | | Soil Analysis: | | |
| Community Age Pioneer Young Mid-Aged Mature Old Growth | | Basal Area (m²/ha) | | Soil Drainage Very Rapid Rapid Well Moderately Well Imperfect Poor Very Poor |
| Standing Snags Rare Occasional Abundant Dominant | | Soil Moisture Regime Dry Fresh Moist Wet | | |
| Deadfall Logs Rare Occasional Abundant Dominant | | Effective Soil Texture | | |
| Healt Low Medium High | Sensitivity Low Medium High | Botanical Quality Low Medium High | | Depth to Mottles / Gley Sample: M - -- cm / G - -- cm |
| Slope none gentle moderate steep (simple or complex) | | Depth to Groundwater metres at surface less than 1m more than 1 m | | Depth to Bedrock metres at surface less than 1m more than 1 m |

| Vegetation Layer | Height ¹ | Cover ² | Dominant Species per Vegetation Layer |
|------------------|---------------------|--------------------|---|
| 1 Canopy | 2 | 2 | ACESASA > ULMAMER |
| 2 Subcanopy | 3 | 3 | ACESASA > ULMAMER |
| 3 Understorey | 4 | 4 | SOLCANA > VITAEST > RHACATH > EUTMACU |
| 4 Ground Layer | 5 | 4 | GRASS SP. > PHAARUN > SOLCANA > BROINER |

¹ Height Code: 1=>20m, 2=10m-20m, 3=2m-10m, 4=1m-2m, 5=0.5m-1m, 6=0.2m-0.5m, 7= < 0.2m ² Cover Codes: 0 = none, 1 = 0%- 10%, 2 = 10%- 25%, 3 = 25%-60%, 4= >60%

| Size Class Analysis ³ | O | O | | |
|--|-------------|-----------------|-----------------|-------------|
| ³ Abundance Code: RS=Rare, O=Occasional, A=Abundant, D=Dominant | < 10 cm DBH | 10 to 24 cm DBH | 25 to 50 cm DBH | > 50 cm DBH |

Evidence of Disturbance:

Wildlife / Habitat Observations / Comments:

| Community Name | | | | Code | % Coverage |
|----------------|--|---------|--|------|------------|
| Inclusion | | Complex | | | |
| Inclusion | | Complex | | | |
| Inclusion | | Complex | | | |

[illegible][illegible]

APPENDIX 4
Vascular Plant List

| Plant ¹ Type | Scientific Name | Common Name | CC ² | CW ³ | SARO ⁴ Status | SARA ⁵ Status | Global ⁶ Rank | Prov. ⁷ Rank |
|------------------------------------|---|-----------------------|------------------------|------------------------|-------------------------------------|-------------------------------------|-------------------------------------|------------------------------------|
| TR | <i>Acer saccharinum</i> | Silver Maple | 5 | -3 | NL | NL | G5 | S5 |
| TR | <i>Acer negundo</i> | Manitoba Maple | 0 | -2 | NL | NL | G5 | S5 |
| FO | <i>Alliaria petiolata</i> | Garlic Mustard | * | 0 | NL | NL | GNR | SNA |
| FO | <i>Anemone canadensis</i> | Canada Anemone | 3 | -3 | NL | NL | G5 | S5 |
| FO | <i>Asclepias syriaca</i> | Common Milkweed | 0 | 5 | NL | NL | G5 | S5 |
| FO | <i>Boehmeria cylindrica</i> | False Nettle | 4 | -5 | NL | NL | G5 | S5 |
| GR | <i>Bromus inermis</i> | Awnless Brome | * | 5 | NL | NL | G5TNR | SNA |
| FO | <i>Cichorium Intybus</i> | Chicory | * | 5 | NL | NL | GNR | SNA |
| FO | <i>Cirsium arvense</i> | Canada Thistle | * | 3 | NL | NL | GNR | SNA |
| FO | <i>Cirsium vulgare</i> | Bull Thistle | * | 4 | NL | NL | GNR | SNA |
| VI | <i>Convolvulus arvensis</i> | Field Bindweed | * | 5 | NL | NL | GNR | SNA |
| SH | <i>Cornus stolonifera</i> | Red Osier Dogwood | 2 | -3 | NL | NL | G5 | S5 |
| FO | <i>Daucus carota</i> | Wild Carrot | * | 5 | NL | NL | GNR | SNA |
| VI | <i>Echinocystis lobata</i> | Wild Mock-cucumber | 3 | -2 | NL | NL | G5 | S5 |
| FE | <i>Equisetum hyemale</i> | Common Scouring-rush | 2 | -2 | NL | NL | G5 | S5 |
| FO | <i>Erigeron philadelphicus</i> | Philadelphia Fleabane | 1 | -3 | NL | NL | G5 | S5 |
| FO | <i>Eutrochium maculatum</i> var. <i>maculatum</i> | Spotted Joe Pye Weed | 3 | -5 | NL | NL | G5T5 | S5 |
| TR | <i>Fraxinus pennsylvanica</i> | Green Ash | 3 | -3 | NL | NL | G5 | S4 |
| GR | Grass sp. | Grass species | | | | | | |
| TR | <i>Juglans nigra</i> | Black Walnut | 5 | 3 | NL | NL | G5 | S4 |
| FO | <i>Leucanthemum vulgare</i> | Oxeye Daisy | * | 5 | NL | NL | GNR | SNA |
| FO | <i>Linaria vulgaris</i> | Butter-and-Eggs | * | 5 | NL | NL | GNR | SNA |
| FO | <i>Lobelia cardinalis</i> | Cardinal Flower | 7 | -5 | NL | NL | G5 | S5 |
| FE | <i>Onoclea sensibilis</i> | Sensitive Fern | 4 | -3 | NL | NL | G5 | S5 |
| FO | <i>Oxalis stricta</i> | European Wood-sorrel | 0 | 3 | NL | NL | G5 | S5 |
| VW | <i>Parthenocissus quinquefolia</i> | Virginia Creeper | 6 | 1 | NL | NL | G5 | S4? |
| GR | <i>Phalaris arundinacea</i> | Reed Canary Grass | 0 | -4 | NL | NL | G5 | S5 |
| GR | Poa sp. | Grass species | | | | | | |
| TR | <i>Populus tremuloides</i> | Trembling Aspen | 2 | 0 | NL | NL | G5 | S5 |

| | | | | | | | | |
|----|---|-----------------------|---|----|----|----|------|-----|
| SH | Rhamnus cathartica | European Buckthorn | * | 3 | NL | NL | GNR | SNA |
| SH | Rubus idaeus ssp. strigosus | Wild Red Raspberry | 0 | -2 | NL | NL | G5T5 | S5 |
| FO | Rudbeckia hirta | Black-eyed Susan | 0 | 3 | NL | NL | G5T5 | S5 |
| FO | Rumex obtusifolius | Bitter Dock | * | -3 | NL | NL | GNR | SNA |
| TR | Salix sp. | Willow species | | | | | | |
| FO | Silene vulgaris | Bladder Campion | * | 5 | NL | NL | GNR | SNA |
| FO | Sium suave | Hemlock Water-parsnip | 4 | -5 | NL | NL | G5 | S5 |
| VI | Solanum dulcamara | Climbing Nightshade | * | 0 | NL | NL | GNR | SNA |
| FO | Solidago canadensis var. canadensis | Canada Goldenrod | 1 | 3 | NL | NL | G5T5 | S5 |
| FO | Symphyotrichum novae-angliae | New England Aster | 6 | 0 | NL | NL | G5 | S5 |
| FO | Symphyotrichum lanceolatum ssp. lanceolatum | Panicked Aster | 3 | -3 | NL | NL | G5 | S5 |
| FO | Taraxacum officinale | Common Dandelion | * | 3 | NL | NL | G5 | SNA |
| TR | Thuja occidentalis | Eastern White Cedar | 4 | -3 | NL | NL | G5 | S5 |
| TR | Tilia americana | Basswood | 4 | 3 | NL | NL | G5 | S5 |
| FO | Toxicodendron radicans | Climbing Poison Ivy | 5 | -1 | NL | NL | G5 | S5 |
| FO | Trifolium pratense | Red Clover | * | 2 | NL | NL | GNR | SNA |
| TR | Tsuga canadensis | Eastern Hemlock | 7 | 3 | NL | NL | G5 | S5 |
| RU | Typha latifolia | Broad-leaved Cattail | 3 | -5 | NL | NL | G5 | S5 |
| TR | Ulmus americana | White Elm | 3 | -2 | NL | NL | G5? | S5 |
| FO | Verbascum thapsus | Common Mullein | * | 5 | NL | NL | GNR | SNA |
| VW | Vitis aestivalis | Summer Grape | 7 | 3 | NL | NL | G5 | S4 |

| | |
|----|--|
| 1. | Plant Types: AL = Algae; FE = Fern; FO = Forb; GR = Grass; LC = Lichen; LV = Liverwort; MO = Moss; RU = Rush; SE = Sedge; SH = Shrub; TR = Tree; VI = Herbaceous vine; VW = Woody Vine |
| 2. | CC: Coefficient of Conservatism reflects a species' fidelity to a specific habitat. Range from 0 to 10; 10 = very conservative, not likely in disturbed habitats, 1 = least conservative, likely found in a broad range of habitat. * = value not assigned because they are non-native |
| 3. | CW: Coefficient of Wetness reflects a species' affinity for wet soil conditions. Range from -5 to 5; -5 = obligate wetland species, 5 = obligate upland species. |
| 4. | SARO: Status under the Provincial Endangered Species Act, listed on the Species at Risk in Ontario (SARO) list. In order of severity, statuses include: EXP = Extirpated; END = |
| 5. | SARA: Status under the National Species at Risk Act (SARA), assessed by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In order of severity, statuses |
| 6. | Global rarity rank. Range from G1 to G5; G1 = Extremely rare, G5 = Very Common. NR = Unranked; U = Unrankable. |
| 7. | Provincial rarity rank. Range from S1 to S5; S1 = Extremely rare, S5 = Very Common. NR = Unranked; U = Unrankable. |

APPENDIX 5
Significant Wildlife Habitat Assessment

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|---|--|--|--|--|---|---------------|-----------------------------------|---------------|
| SEASONAL CONCENTRATION AREAS OF ANIMALS | | | | | | | | |
| 1 | Waterfowl stopover and Staging Areas (terrestrial) | - Fields with Sheet water in spring (incl. agricultural) | - Mixed species aggregations of 100 or more individuals confirms SWH | flooded field ecosite and 100-300m radius is the SWH | No habitat matching criteria identified in Study Area | No | None required | No |
| 2 | Waterfowl Stopover and Staging (Aquatic) | - Ponds, marshes, lakes, bays, coastal inlets and watercourses and reservoirs - SWTP & SWMP are not SWH | - Aggregations of 100 or more listed species for 7 days (ie. >700 waterfowl use days) confirms SWH | Aquatic ecosite and 100m radius is the SWH | No habitat matching criteria identified in Study Area | No | None required. | No |
| 3 | Shorebird Migratory stopover | - Shorelines of Lakes, rivers, wetlands, beaches, bars; seasonally flooded, muddy and un-vegetated shoreline habitat | - 3 or more listed species and >1000 shorebird use days, or >100 whimbrel, confirms SWH | Shoreline ecosite and 100m radius is the SWH | No Habitat matching Criteria identified in Study Area, >5km from any Lake Ontario | No | None required. | No |
| 4 | Raptor Wintering Area | - Combination of upland field and woodland habitat >20ha total (includes, >15ha upland field) - least disturbed sites, idle, fallow or lightly grazed field/meadow best | - 1 or more Short-eared Owl, or, at least 10 individuals and 2 listed species for a minimum of 20 days, and 3 of 5 years, confirms SWH | Ecosite communities (field and woodland) is the SWH | No habitat matching criteria identified in Study Area | No | None required. | No |
| 5 | Bat Hibernacula | - Caves, mine shafts, underground foundations, karsts - buildings are not SWH | - All sites with confirmed hibernating bats, confirms SWH | Ecosite and 200m radius is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 6 | Bat Maternity Colony | - All forested ecosites, FOD, FOC, FOM, SWD, SWM, SWC with >10/ha trees (>25cm DBH) in early stages of decay (class 1-3) - buildings are not SWH | - >10 Big Brown Bats, >20 Little Brown Myotis, >5 adult female Silver-haired Bats confirms SWH | Entire woodland or forest stand ELC ecosite containing colony is the SWH | Forested ecosites present in Study area with trees >25cm DBH. | Yes | None required. | unknown |

APPENDIX 5. CANDIDATE SIGNIFICANT WILDLIFE HABITAT ASSESSMENT

Project #: AA17-119A

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|----|--|---|--|---|---|---------------|---|---------------|
| 7 | Turtle Wintering Area | - Areas with permanent water deep enough not to freeze, with mud/soft substrates | - 5 over-wintering Midland Painted Turtles, 1 or more Northern Map Turtle or Snapping Turtle confirms SWH | Mapped ELC ecosite, or deep pool element where turtles overwinter is the SWH | No habitat matching criteria identified in Study Area | No | No turtles identified incidentally or observed in community during summer and fall surveys. | No |
| 8 | Reptile Hibernaculum | - Sites below the frost line; rock barren, crevice and cave, talus, alvar, rock piles, slopes, stone fences and crumbling foundations | - Presence of hibernacula with minimum 5 individuals of 1 snake species/ individuals of 2 or more species confirms SWH - Congregations of a minimum of 5 snakes of 1 species/ individuals of 2 or more snake species, near potential hibernacula on sunny warm days in spring and fall confirms SWH | Feature hibernacula is located in, and 30m radius is the SWH | No habitat matching criteria identified in Study Area | No | None required | No |
| 9 | Colonially-nesting Bird Habitat (cliff/bank) | - Eroding banks, sandy hills, borrow pits, steep slopes, sand piles, cliff faces, bridge abutments, silos, barns | - 1 or more nest sites with 8 or more Cliff Swallow or, 50 Bank Swallow and Rough-winged Swallow pairs during the breeding season. | Colony and 50m radius around peripheral nest is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 10 | Colonially-nesting Bird Habitat (Tree/shrub) | - Live or dead standing trees in wetlands, lakes, islands and peninsulas, occasionally shrubby and emergent vegetation | - 5 or more active Great-blue Heron or other listed species nests | Edge of the colony plus minimum 300m radius, or extent of the forest ecosite, or entire island <15ha is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 11 | Colonially-nesting Bird Habitat (Ground) | - Rocky islands or peninsulas within a lake or large river(natural or artificial) | - >25 active nests of Herring Gull, Ring-billed Gull, >5 active nests of Common Tern, or >2 active nests of Caspian Tern. 5 or more pairs of Brewer's Blackbird. Any active nesting colony of Little Gull, Great Black-backed Gull. | Edge of colony plus min 150m radius or extent of ELC ecosite, or island <3ha is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 12 | Migratory Butterfly Stopover Area | - At least 10ha, with undisturbed field/meadow and forest or woodland edge habitat present, within 5km of Lake Ontario. | - Presence of Monarch use days >5000 or >3000 where there is a mix of Monarch with Painted Ladies or White Admirals | Field/meadow and forest/woodland is the SWH | No Habitat matching Criteria identified in Study Area, >5km from Lake Ontario | No | None required. | No |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|------------------------------------|------------------------------------|--|--|---|--|---------------|-----------------------------------|---------------|
| 13 | Land bird Migratory Stopover Area | - Woodlots >5ha in size - within 5km of lake Ontario | - Use by >200 birds/day, with >35species, with at least 10sp recorded on 5 different survey dates. | Woodlot is the SWH | No Habitat matching Criteria identified in Study Area, >5km from Lake Ontario | No | None required. | No |
| 14 | Deer Yarding Areas | - ELC communities providing Thermal cover (FOM,FOC,SWM,SWC, CUP2, CUP3, FOD3, CUT) | - Deer yards are managed by MNRF, available through district offices and LIO. | LIO mapping | No Deer yarding areas identified on LIO Mapping | No | None required. | No |
| 15 | Deer Winter Congregation Areas | - All forested ecosites >100ha - Conifer Plantations <50ha may be used | - Deer management is the responsibility of the MNRF - Contact MNRF or LIO for known deer winter areas. | LIO mapping | Deer Wintering Areas identified by LIO within Greenock PSW south of Highway 9. | Yes | None required. | Yes |
| RARE VEGETATION COMMUNITIES | | | | | | | | |
| 16 | Cliffs & Talus Slopes | - Cliff: vertical to near vertical bedrock >3m in height - Talus slope: rock rubble at the base of a cliff made up of coarse rocky debris | - Confirm any ELC Vegetation Type for Cliffs or Talus Slopes | Area of ELC sites: TAO, TAS, TAT, CLO, CLS, CLT | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 17 | Sand Barren | - Exposed, sparsely vegetated & caused by lack of moisture, fires and erosion. | - area >0.5ha in size - Confirm any ELC vegetation Type for Sand Barren - Not dominated by exotic or introduced species | Area of ELC ecosite is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 18 | Alvar | - Level, mostly un-fractured calcareous bedrock feature, overlain by a thin veneer or soil | - area >0.5ha in size - Field Studies that identify four of the five Alvar Indicator Species - Not dominated by exotic or introduced species | Area of ELC ecosite is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 19 | Old Growth Forest | - >30ha forests with at least 10ha interior habitat and multi-layered canopy | - Dominant Tree Species >140 years old - No recognizable signs forestry practices (old stumps) | Area of ELC ecosite is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |
| 20 | Savannah | - Tall Grass Prairie Habitat with 25%-60% Tree cover - Remnant sites such as Railway Right of ways are not SWH | - No minimum size, and must be restored to a natural state. - Confirm one or more savannah indicator species - Not dominated by exotic or introduced species | Area of ELC ecosite is the SWH | No Habitat matching Criteria identified in Study Area | No | None required | No |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|----------------------------------|---|---|--|--|---|---------------|-----------------------------------|---------------|
| 21 | Tallgrass Prairie | <ul style="list-style-type: none"> - Ground cover dominated by prairie grasses with <25% tree cover - Remnant sites such as Railway Right of ways are not SWH | <ul style="list-style-type: none"> - No minimum size, and must be restored to a natural state. - Confirm one or more prairie indicator species - Not dominated by exotic or introduced species | Area of ELC ecosite is the SWH | No habitat matching criteria identified in Study Area | No | None required | No |
| 22 | Other Rare Vegetation Communities | <ul style="list-style-type: none"> - All Provincially Rare S1, S2, S3 Vegetation Communities (Appendix M of SWHTG) | <ul style="list-style-type: none"> - Field Studies Confirming ELC vegetation type is a rare vegetation community | Area of ELC ecosite is the SWH | No communities identified on site are S1-S3 communities | No | None required | No |
| SPECIALIZED HABITAT FOR WILDLIFE | | | | | | | | |
| 23 | Waterfowl Nesting Areas | <ul style="list-style-type: none"> - Upland Habitat, adjacent to Wetland ELC ecosites (except SWC, SWM) - Extends 120m from a wetland (>0.5ha) and any small wetlands (<0.5ha) within a cluster of at least 3 - Upland area at least 120m wide | <ul style="list-style-type: none"> - Presence of 3 or more nesting pairs of listed species excluding Mallards - Presence of 10 or more nesting pairs including mallards - Any active Black Duck nesting site | SWH may be greater than or less than 120m from the wetland edge and must provide enough habitat for waterfowl to successfully nest | There are no upland treed communities adjacent to wetlands within the Study Area. | No | None required | No |
| 24 | Bald Eagle or Osprey Nesting, Foraging and Perching Habitat | <ul style="list-style-type: none"> - Forest communities, adjacent to riparian areas - Osprey nests usually at top of tree - Bald Eagle nest usually in super canopy tree in a notch within canopy | <ul style="list-style-type: none"> - Studies confirm one or more active Bald Eagle or Osprey nest - Alternate nests included in SWH - Nests must be used annually, if found inactive, must be known inactive at least 3 years, or suspected unused for 5 years if unknown | Active nest plus 300m for Osprey Active nest plus 400-800m for Bald Eagle | No habitat matching criteria identified in Study Area | No | None required | No |
| 25 | Woodland Raptor Nesting Habitat | <ul style="list-style-type: none"> - Forested communities, forested swamp communities and cultural Plantations - Natural Forested/conifer plantations >30ha with >10ha interior habitat (200m buffer) | <ul style="list-style-type: none"> - One or more active nest of listed species | Nest protection radius: <ul style="list-style-type: none"> - Red-Shouldered Hawk, Northern Goshawk 400m - Barred Owl 200m - Broad-winged Hawk, Coopers Hawk 100m - Sharp-shinned Hawk 50 | Forested habitat within study area is < 30ha in area. | No | None required. | No |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|----|---------------------------------------|--|---|--|---|---------------|-----------------------------------|--------------------------------|
| 26 | Turtle Nesting Areas | <ul style="list-style-type: none"> - Exposed Mineral soil (sand or gravel) adjacent (<100m) or within shallow marsh, shallow submerged, shallow floating, bog or fen communities - Located in open sunny areas, away from roads and less prone to predation - Municipal and provincial road shoulders are not SWH. | <ul style="list-style-type: none"> - Confirm 5 or more nesting Midland Painted Turtles, 1 or more nesting Northern Map Turtle or Snapping Turtle | Area or sites with exposed mineral soils, plus a radius of 30-100m around the nesting area is the SWH. | No habitat matching criteria identified in Study Area | No | None required | No |
| 27 | Seeps and Springs | <ul style="list-style-type: none"> - Areas where ground water comes to the surface - Any forested area within the headwaters of a stream or river system | <ul style="list-style-type: none"> - Confirm site with 2 or more seeps/springs. | Area of ELC forest ecosite containing seep/spring is the SWH | Seeps and springs possible within wetland communities | Yes | ELC complete | No seeps or springs identified |
| 28 | Amphibian Breeding Habitat (woodland) | <ul style="list-style-type: none"> - Breeding pools within woodlands - Wetland, pond or pool >500m² within or adjacent (<120m) to a woodland. - Woodlands with permanent ponds, or those with water until mid-July more likely to be used. | <ul style="list-style-type: none"> - Confirm Breeding population of 1 or more listed newt/salamander species, 2 or more of the listed frog species with at least 20 individuals (adults or egg masses), 2 or more of the listed frog species with call code levels of 3. - Wetland adjacent to woodlands includes travel corridor connecting features as SWH. | Wetland area, plus 230m radius of woodland is the SWH. | No habitat matching criteria identified in Study Area | No | None required. | No |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|--|--------------------------------------|---|--|--|---|---------------|-----------------------------------|---------------|
| 29 | Amphibian Breeding Habitat (Wetland) | <ul style="list-style-type: none"> - Swamp, marsh, fen, bog, open aquatic and shallow aquatic ELC communities. - Typically isolated from woodlands (>120m), but includes larger wetlands with primarily aquatic species (bull frogs) that are adjacent to woodlands. - Wetlands >500m² - Presence of shrubs & logs - Bullfrogs require permanent water bodies and abundant emergent vegetation. | <ul style="list-style-type: none"> - Confirm Breeding populations of 1 or more listed newt/salamander species, or 2 or more listed frog/toad species with at least 20 individuals (adults or egg masses), or 2 or more listed frog/toad species with a call code level of 3 - Or any wetland with confirmed breeding Bullfrog. | ELC ecosite and shoreline is the SWH Movement corridors (SWH) must be considered if this habitat is significant | Unevaluated wetland communities and those within Greenock Swamp PSW within study area may provide suitable habitat. | Yes | None required. | Unknown |
| 30 | Area-sensitive Breeding Bird Habitat | <ul style="list-style-type: none"> - Habitats where interior breeding birds are breeding - Large mature(>60 years) forest stands or woodlots >30ha - Forest and swamp ELC communities - Interior habitat at least 200m from edge | <ul style="list-style-type: none"> - Presence of nesting or breeding pairs of 3 or more of the listed species - Any site with Cerulean Warbler or Canada Warbler is SWH - | ELC ecosite is the SWH | No interior habitat (>200m) identified in study area | No | None required | No |
| HABITATS OF SPECIES OF CONSERVATION CONCERN CONSIDERED SWH | | | | | | | | |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|----|--|--|---|--|---|---------------|-----------------------------------|---------------|
| 31 | Marsh Bird Breeding Habitat | <ul style="list-style-type: none"> - Some meadow marsh, shallows submerged, shallow floating, mixed shallow floating, fen and bog communities (see SWH Ecoregion guide for specifics) - Nesting occurs in wetlands, all wetland habitat is considered with presence of shallow water with emergent aquatic vegetation - Green heron at edge of water sheltered by shrubs and trees. | <ul style="list-style-type: none"> - 5 or more nesting pairs of Sedge Wren or Marsh Wren, 1 pair of Sandhill Crane, or breeding by any combination of 5 or more of the listed species - Any Wetland with 1 or more breeding pair Black Tern, Trumpeter Swan, Green Heron or Yellow Rail | ELC ecosite is the SWH | No marsh habitat present in Study Area | No | None required. | No |
| 32 | Open Country Bird Breeding Habitat | <ul style="list-style-type: none"> - Grassland area >30ha (natural & cultural fields and meadows) - Grasslands not class 1 or 2 agriculture (no row crops or intensive hay or livestock pasturing) - Mature hayfields or pasture at least 5 years old | <ul style="list-style-type: none"> - Nesting or breeding of 2 or more of the listed species - Field with 1 or more Short-eared Owls | Contiguous ELC ecosite is the SWH | No habitat matching criteria identified in Study Area | No | None required. | No |
| 33 | Shrub/Early Successional Bird Breeding Habitat | <ul style="list-style-type: none"> - Cultural thickets, savannah and woodland habitat - Large field area succeeding to shrub and thicket habitat >10ha in size - Patches of shrub ecosite may be complexed into larger old field ecosites for some species | <ul style="list-style-type: none"> - Confirm nesting or breeding of 1 of the listed indicator species and at least 2 of the common species - Habitat with Yellow-breasted Chat Or Golden-winged Warbler is SWH | SWH is contiguous ELC ecosite field/thicket area | No habitat matching criteria identified in Study Area | No | None required | No |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|---------------------------|---|--|--|--|--|--|--|---------------|
| 34 | Terrestrial Crayfish | <ul style="list-style-type: none"> - Meadow marsh, shallow marsh, swamp thicket, deciduous swamp and mixed swamp communities - Cultural meadow with inclusions of meadow marsh may be used - Wet edges of marshes and wet meadows should be surveyed for crayfish | <ul style="list-style-type: none"> - Presence of 1 or more individuals of listed species or their chimneys in suitable habitat | Area of ELC ecosite or Eco element area of meadow marsh or swamp within the larger ecosite area is the SWH | Swamp communities as well as edges adjacent to agricultural fields may provide suitable habitat | Yes | None required. | Unknown |
| 35 | Special Concern & Rare Wildlife Species | <ul style="list-style-type: none"> - All Special concern and Provincially Rare plant and animal species - Where an element occurrence is identified within a 1 or 10km grid for a species listed, linking candidate habitat on the site must be completed to ELC ecosites | <ul style="list-style-type: none"> - Assessment/inventory of site for identified special concern or rare species completed during time of year when species is present or easily identifiable - Habitat must be easily mapped and cover an important life stage component (specific nesting habitat, foraging) | SWH is the finest ELC scale that protects the form and function of the habitat | <p>One element occurrences for Special Concern or rare Wildlife Species identified within 1km of the study area</p> <ul style="list-style-type: none"> - Snapping Turtle (NHIC) <p>Background Atlas review identified 6 Special concern species within 10km of the Study Area</p> <ul style="list-style-type: none"> - Snapping Turtle (ORAA) - Grasshopper Sparrow (OBBA) - Eastern Wood-pewee (OBBA) - Wood Thrush (OBBA) - Golden-winged Warbler (OBBA) | Yes- Woodlands on site and within 120m may provide habitat for Eastern-Wood-pewee and Wood Thrush. Riverine and swamp habitat on site, and within 120m may provide habitat for Common Snapping Turtle. | Two-season ELC and Botanical survey, Incidental Wildlife | No |
| ANIMAL MOVEMENT CORRIDORS | | | | | | | | |

| # | SIGNIFICANT WILDLIFE HABITAT (SWH) | CANDIDATE SWH CRITERIA | CRITERIA FOR SWH CONFIRMATION | SWH PROTECTED AREA | SITE ASSESSMENT DETAILS | CANDIDATE SWH | FIELD STUDIES REQUIRED/ COMPLETED | CONFIRMED SWH |
|----|------------------------------------|---|--|---------------------|--|---------------|-----------------------------------|---------------|
| 36 | Amphibian Movement Corridor | <ul style="list-style-type: none"> - Corridors may occur in all ecosites associated with water - Presence of significant amphibian breeding indicates the requirement for identifying corridors - Movement corridors between breeding habitat and summer habitat | <ul style="list-style-type: none"> - Corridors typically include areas with native vegetation, with several layers of vegetation, unbroken by roads, waterways or waterbodies are most significant - At least 15 of vegetation on both sides of the waterway or up to 200m wide of woodland habitat with gaps of <20m - Shorter corridors are more significant than longer, but amphibians must be able to get to and from their summer breeding habitat | Corridor is the SWH | Potential for amphibian breeding habitat and therefore Amphibian Movement Corridor within the Swamp communities. | Yes | None required | Unknown |
| 37 | Deer Movement Corridor | <ul style="list-style-type: none"> - May occur in all forested ecosites - Determined when deer wintering habitat is confirmed as SWH | <ul style="list-style-type: none"> - Corridors at least 200m wide with gaps <20m leading to wintering habitat - Unbroken by roads and residential areas - Shorter corridors are more significant | Corridor is the SWH | Deer wintering habitat is present within the Greenock Swamp PSW south of Highway 9 | Yes | None required | Unknown |

APPENDIX 6
Species at Risk Habitat Assessment

| COMMON NAME | SCIENTIFIC NAME | SARO | COSEWIC | S-RANK | BACKGROUND SOURCES | HABITAT REQUIREMENTS | SUITABLE HABITAT IN STUDY AREA | FIELD STUDIES COMPLETED/ REQUIRED | OBSERVED BY A & A | REFERENCE |
|---|------------------------------|------|---------|----------|---|--|---|---|----------------------------|--|
| Butterflies, Bees, Damselflies, Dragonflies & Insects | | | | | | | | | | |
| Hungerford's Crawling Water Beetle | Brychius hungerfordi | END | END | S1 | MNRF (Bruce County) | Found in small to medium-sized streams with moderate to fast flow, good stream aeration, cool temperatures, inorganic substrate and alkaline water conditions (COSEWIC 2011) | The Teeswater River may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required. | None observed. | COSEWIC. 2011. COSEWIC assessment and status report on the Hungerford's Crawling Water Beetle <i>Brychius hungerfordi</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 40 pp. |
| Rusty-patched Bumble Bee | <i>Bombus affinis</i> | END | END | S1 | MNRF (Bruce County) | Uses a variety of open or semi-open habitat, including meadows, agricultural land and savannah habitat for foraging. Nests are often found underground, in old rodent burrows (COSEWIC 2010c). | Agricultural fields along the outer edge of the study area may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required. | None observed. | COSEWIC. 2010. COSEWIC assessment and status report on the Rusty-patched Bumble Bee Bombus affinis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 34 pp. |
| Birds | | | | | | | | | | |
| Bald Eagle | Haliaeetus leucocephalus | SC | NAR | S2N, S4B | MNRF (Bruce County) | Prefers deciduous and mixed-deciduous mature forest habitat close to water bodies including lakes and rivers; nests in super canopy trees including Pine (Armstrong 2014). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required. | None observed. | Armstrong, Ted (E.R.). 2014. Management Plan for the Bald Eagle (Haliaeetus leucocephalus) in Ontario. Ontario Management Plan Series. Prepared for the Ontario Ministry of Natural Resources and Forestry, Peterborough, Ontario. vii + 53 pp. |
| Bank Swallow | <i>Riparia riparia</i> | THR | THR | S4B | OBBA (2007) | Breeds in a variety of natural and artificial bank type habitat, such as bluffs, stream and river banks, sand and gravel pits, piles of sand, topsoil and other material. Nests are typically in vertical or near-vertical surfaces (COSEWIC 2013b). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2013. COSEWIC assessment and status report on the Bank Swallow Riparia riparia in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 48 pp. |
| Barn Swallow | <i>Hirundo rustica</i> | THR | THR | S4B | OBBA (2007) MNRF (Bruce County) | Occurs in farmland, along lake/river shorelines, in wooded clearings and in urban populated areas. Nesting may occur inside or outside buildings; under bridges and in road culverts (COSEWIC 2011a). | Bridges and structures within the Study Area provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | Nesting evidence observed. | COSEWIC. 2011. COSEWIC assessment and status report on the Barn Swallow <i>Hirundo rustica</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. ix + 37 pp. |
| Black Tern | Chlidonias niger | SC | NAR | S3B | MNRF (Bruce County) | Breeds in large, freshwater marshes, with emergent vegetation, and large areas of open water. Nests are typically within 6 meters of the water, on low emergent vegetation (Burke 2012). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Peter S. Burke. 2012. Management Plan for the Black Tern (Chlidonias niger) in Ontario. Ontario Management Plan Series. Prepared for the Ontario Ministry of Natural Resources (OMNR), Peterborough, Ontario. vi + 47 pp. |
| Bobolink | <i>Dolichonyx oryzivorus</i> | THR | THR | S4B | NHIC (2004) OBBA (2007) MNRF (Bruce County) | Nest in grassland habitats, including hayfields and meadows with a mixture of grasses and broad-leaved forbs with a high litter cover. Area Sensitive, with increased density in grasslands greater than 10ha (Renfrew et. al. 2015) | Fields adjacent to the river corridor may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed | Renfrew, R., A.M. Strong, N.G. Perlut, S.G. Martin and T.A. Gavin. 2015. Bobolink (Dolichonyx oryzivorus), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Birds of North America Online: http://bna.birds.cornell.edu/bna/species/176 |
| Cerulean Warbler | <i>Setophaga cerulea</i> | THR | END | S3B | MNRF (Bruce County) | Occur in older, mature, deciduous forests, preferentially oak-maple composition, with a full, to partially open canopy, and little to no understory cover. Often in bottomland forests, or adjacent to treed swamplands (COSEWIC 2010f). | No deciduous forests adjacent to the treed swamplands within the study area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2010. COSEWIC assessment and status report on the Cerulean Warbler Dendroica cerulea in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 40 pp. |

| COMMON NAME | SCIENTIFIC NAME | SARO | COSEWIC | S-RANK | BACKGROUND SOURCES | HABITAT REQUIREMENTS | SUITABLE HABITAT IN STUDY AREA | FIELD STUDIES COMPLETED/ REQUIRED | OBSERVED BY A & A | REFERENCE |
|------------------------|------------------------------|------|---------|--------|---------------------------------|---|--|--|-------------------|---|
| Eastern Meadowlark | <i>Sturnella magna</i> | THR | THR | S4B | OBBA (2007) MNRF (Bruce County) | Nest in grassland habitats, including hayfields, pasture, savannahs, and other open areas. Preferential habitat includes areas with good grass and thatch (litter) cover (Jaster et. al. 2012). | Fields adjacent to the river corridor may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | aster, Levi A., William E. Jensen and Wesley E. Lanyon. (2012). Eastern Meadowlark (<i>Sturnella magna</i>), The Birds of North America (P. G. Rodewald, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America: https://birdsna.org/Species-Account/bna/species/easmea |
| Eastern Whip-poor-will | <i>Caprimulgus vociferus</i> | THR | THR | S4B | MNRF (Bruce County) | Often found breeding in semi-open habitats, with little ground cover, and canopy openings allowing light to penetrate the forest floor, often associated with pine or oak, savannahs and barrens, early-successional poplar stands and open conifer plantations (COSEWIC 2009a) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2009. COSEWIC assessment and status report on the Whip-poor-will Caprimulgus vociferus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 28 pp. |
| Eastern Wood-pewee | <i>Contopus virens</i> | SC | SC | S4B | OBBA (2007) | Associated with mid-age mixed and deciduous forest stands, often dominated by Maple (Acer), Elm (Ulmus) or Oak (Quercus), and include areas with clear-cuts, openings or forest edges. Also prefers forest stands with little to no understory vegetation (COSEWIC 2012a). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | ? COSEWIC. 2012. COSEWIC assessment and status report on the Eastern Wood-pewee Contopus virens in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. x + 39 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm). |
| Golden-winged Warbler | Vermivora chrysoptera | SC | THR | S4B | OBBA (2007) MNRF (Bruce County) | Nests in early successional shrub habitat, with adjacent forest edges for singing perches, often in hydro cut-overs, recently logged areas and beaver marshes (COSEWIC 2006a). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2006. COSEWIC assessment and status report on the Golden-winged Warbler Vermivora chrysoptera in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 30 pp. |
| Grasshopper Sparrow | <i>Ammodramus savannarum</i> | SC | SC | S4B | OBBA (2007) | Prefers moderately open grasslands and prairies with patchy bare ground; avoids grasslands with extensive shrub cover (Vickery 1996). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Vickery, Peter D. 1996. Grasshopper Sparrow (<i>Ammodramus savannarum</i>), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online: http://bna.birds.cornell.edu/bna/species/239/ |
| Henslow's Sparrow | <i>Ammodramus henslowii</i> | END | END | SHB | MNRF (Bruce County) | Breeds in grassland habitat, and is area sensitive. Grasslands with tall, dense cover a thick thatch layer, and are greater than 30ha, but preferentially larger than 100ha are preferred (COSEWIC 2011b). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2011. COSEWIC assessment and status report on the Henslow's Sparrow <i>Ammodramus henslowii</i> in Canada. Committee on the Status of Endangered Wildlife in Canada . Ottawa. x + 37 pp. |
| King Rail | <i>Rallus elegans</i> | END | END | S2B | MNRF (Bruce County) | Occupies a variety of freshwater marsh habitat types. Those with a range of water level conditions and a mosaic of habitats are preferable (COSEWIC 2011) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2011. COSEWIC assessment and status report on the King Rail <i>Rallus elegans</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. X + 32 pp. |
| Least Bittern | Ixobrychus exilis | THR | THR | S4B | MNRF (Bruce County) | Breeds in large marshes (>5ha) with emergent vegetation, typically cattails, with at least 50% open water, and relatively stable water levels (COSEWIC 2009b). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2009. COSEWIC assessment and update status report on the Least Bittern Ixobrychus exilis in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 36 pp. |
| Loggerhead Shrike | <i>Lanius ludovicianus</i> | END | END | S2B | MNRF (Bruce County) | Nests in open, low, grassy habitat with scattered shrubs. Presence of thorny shrubs, such as hawthorn, or barbwire fencing required for impaling prey. Only two recent areas of breeding in the province (Carden Plain and Napanee Plain) (Environment Canada 2015). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Environment Canada. 2015. Recovery Strategy for the Loggerhead Shrike, migrans subspecies (Lanius ludovicianus migrans), in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. vii + 35 pp. |

APPENDIX 6. SPECIES AT RISK HABITAT ASSESSMENT

PROJECT #: AA17-119A

[illegible]

| COMMON NAME | SCIENTIFIC NAME | SARO | COSEWIC | S-RANK | BACKGROUND SOURCES | HABITAT REQUIREMENTS | SUITABLE HABITAT IN STUDY AREA | FIELD STUDIES COMPLETED/ REQUIRED | OBSERVED BY A & A | REFERENCE |
|---------------------|------------------------------|------|---------|--------|---|--|--|--|-------------------|---|
| American Badger | <i>Taxidea taxus</i> | END | END | S2 | MNRF (Bruce County) | Associated with open habitat, including agricultural hedgerows, grasslands, fallow habitat and open linear corridors in forests. Soil composition must be coherent to maintain structure for digging and tunneling, usually coarse silts to fine sands, in Ontario usually found in areas of sandy and loam soils. Prey availability is also important for site suitability (COSEWIC, 2012c). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2012. COSEWIC assessment and status report on the American Badger <i>Taxidea taxus</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. iv + 63 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm). |
| Little Brown Myotis | <i>Myotis lucifugus</i> | END | END | S4 | OMA (1994) | Hibernate in Caves; maternity colonies located in warm sites, often associated with human habitation; including attics, old buildings, under bridges, rock crevices and cavities in canopy trees in wooded areas (COSEWIC, 2013c). | The bridge and other structures within the Study Area may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2013a COSEWIC assessment and status report on the Little Brown Myotis <i>Myotis lucifugus</i> , Northern Myotis <i>Myotis septentrionalis</i> and Tri-colored Bat <i>Perimyotis subflavus</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xxiv + 93 pp. (www.registrelep-sararegistry.gc.ca/default_e.cfm). |
| Reptiles | | | | | | | | | | |
| Blanding's Turtle | <i>Emydoidea blandingii</i> | THR | THR | S3 | MNRF (Bruce County) | Use a variety of eutrophic wetland habitat types, including lakes, ponds, watercourses, marshes, man-made channels, farm fields, coastal areas and bays. Seasonal overland terrestrial movements up to 2.5 km occur to reach nesting and overwintering areas, generally through wooded coniferous or mixed forest habitat. Nests are usually laid in loose sand or organic soil (COSEWIC 2005b). | The Teeswater River and surrounding wetland may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2005. COSEWIC assessment and update status report on the Blanding's Turtle <i>Emydoidea blandingii</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. viii + 40 pp. (www.sararegistry.gc.ca/status/status_e.cfm). |
| Northern Map Turtle | <i>Graptemys geographica</i> | SC | SC | S3 | MNRF (Bruce County) | Highly aquatic species, found in deep, large waterbodies, including Lakes and large rivers, with abundant basking sites. Emerge onto land only during nesting, which occurs in soft sand or soil. Waterbodies with slow currents, soft mud bottoms and abundant aquatic vegetation are preferred (COSEWIC, 2002b). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2002. COSEWIC assessment and status report on the northern map turtle <i>Graptemys geographica</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 34 pp. |
| Snapping Turtle | <i>Chelydra serpentina</i> | SC | SC | S3 | NHIC (2004) ORAA (2016) MNRF (Bruce County) | Inhabit slow-moving waters with soft, muck bottom and dense aquatic vegetation. Ponds, sloughs and shallow bays are all often used as summering and overwintering habitat (COSEWIC 2008d). | The Teeswater River and surrounding wetland may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2008. COSEWIC assessment and status report on the Snapping Turtle <i>Chelydra serpentina</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 47 pp. (www.sararegistry.gc.ca/status/status_e.cfm). |
| Eastern Ribbonsnake | <i>Thamnophis sauritus</i> | SC | SC | S3 | MNRF (Bruce County) | A semi-aquatic species that inhabits dense, low- vegetation, edges of ponds, streams, marshes, fens and bogs, with open sunlit areas for basking (COSEWIC 2002c). | The Teeswater River and surrounding wetland may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2002. COSEWIC assessment and status report on the eastern ribbonsnake <i>Thamnophis sauritus</i> . Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp. |
| Queensnake | <i>Regina septemvittata</i> | END | END | S2 | MNRF (Bruce County) | Associated with rocky streams and rivers, but also found in marsh, pond and lake shore habitats. Typically found within 3m of the shoreline and only where there is an abundance of Crayfish (COSEWIC 2010) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2010. COSEWIC assessment and status report on the Queensnake <i>Regina septemvittata</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 34 pp. |

| COMMON NAME | SCIENTIFIC NAME | SARO | COSEWIC | S-RANK | BACKGROUND SOURCES | HABITAT REQUIREMENTS | SUITABLE HABITAT IN STUDY AREA | FIELD STUDIES COMPLETED/ REQUIRED | OBSERVED BY A & A | REFERENCE |
|--------------------------------|----------------------------------|------|---------|--------|---------------------|---|---|--|-------------------|--|
| Massasauga Rattlesnake | <i>Sistrurus catenatus</i> | SC | THR | S3 | MNRF (Bruce County) | Found in wet prairies, old fields, peatlands, rock barrens and coniferous forests, with open-areas, and areas of dense shrub cover. Hibernate in damp areas below the frost line (COSEWIC, 2012b). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2012. COSEWIC assessment and status report on the Massasauga Sistrurus catenatus in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xiii + 84 pp. |
| Vascular Plants | | | | | | | | | | |
| American Ginseng | <i>Panax quinquefolius</i> | END | END | S2 | MNRF (Bruce County) | Occurs in moist, rich, undisturbed, mature Sugar Maple dominated deciduous woodlands. Often, colonies are located at the bottom of south facing slopes (COSEWIC, 2000). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2000. COSEWIC assessment and update status report on the American ginseng Panax quinquefolius in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 17 pp. |
| American Hart’s Tongue Fern | <i>Asplenium scolopendrium</i> | SC | SC | S3 | MNRF (Bruce County) | Grows on rocks or rocky substrates and requires calcareous soils, preferential to sites with dolomitic limestone, in Ontario found in upper talus and mid-slopes of the Niagara Escarpment (Environment Canada 2013). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Environment Canada. 2013. Management Plan for the Hart’s-tongue Fern (Asplenium scolopendrium) in Canada. Species at Risk Act Management Plan Series. Environment Canada, Ottawa. iii + 16 pp |
| Broad Beech Fern | <i>Phegopteris hexagonoptera</i> | SC | | | MNRF (Bruce County) | Prefers rich, undisturbed mature deciduous forest, particularly mature Beech-Maple forests. Typically found in moist topography such as lower valley slopes, bottomlands and swamps (van Overbeeke, J.C et al. 2013) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Van Overbeeke, J.C., J.V. Jalava and R.H. Donely. 2013. Management Plan for the Broad Beech Fern (<i>Phegopteris hexagonoptera</i>) in Ontario. Ontario Management Plan Series. Prepared for the Ontario Ministry of Natural Resources, Peterborough, Ontario. V + 25 pp. |
| Dwarf Lake Iris | <i>Iris lacustris</i> | SC | | | MNRF (Bruce County) | Occurs on alvars, dolostone bedrock shorelines, sand or gravel beach ridges, and in opening in coniferous woodlands. Most of the populations are within 500m of the shore of Lake Huron, but the largest ones occur up to several kilometres from the lake (COSEWIC 2010) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 201. COSEWIC assessment and status report on the Dwarf Lake Iris <i>Iris lacustris</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xi + 29 pp. |
| Eastern Prairie-fringed Orchid | <i>Platanthera leucophaea</i> | END | END | S2 | MNRF (Bruce County) | Habitat includes fens, wet tallgrass prairie and moist old fields with open growing conditions. Species does not flower annually (Environment Canada 2012). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Environment Canada. 2012. Recovery Strategy for the Eastern Prairie Fringed-orchid (Platanthera leucophaea) in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. ii + 11 pp. + Appendices. |
| Gattinger's Agalinis | <i>Agalinis gattingeri</i> | END | | | MNRF (Bruce County) | Found in alvar and tallgrass prairie habitats with short, sparse vegetative cover, and open unshaded conditions. Can survive in various moisture regimes (Environment and Climate Change Canada 2017) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | Environment and Climate Change Canada. 2017. Recovery Strategy for the Gattinger’s Agalinis (<i>Agalinis gattingeri</i>) in Canada [Proposed]. <i>Species at Risk Act</i> Recovery Strategy Series. Environment and Climate change Canada, Ottawa. 3 parts, 44 pp. + vi + 33 pp. + 7 pp. |
| Hill's Pondweed | <i>Potamogeton hillii</i> | SC | SC | S2 | MNRF (Bruce County) | Occur in cold clear calcareous streams, ponds and ditches, which are alkaline in nature (COSEWIC 2005c). | Teeswater River may provide suitable habitat | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2005c COSEWIC assessment and update status report on the Hill's pondweed Potamogeton hillii in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 19 pp. |
| Hill's Thistle | <i>Cirsium hillii</i> | THR | | | MNRF (Bruce County) | Found in a variety of open, dry, sandy, fire-prone habitats including bluff prairies, oak barrens and sand dunes. Requires open conditions and usually found with Poverty Oak Grass dominating the ground layer (COSEWIC 2004) | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2004. COSEWIC assessment and status report on Hill’s Thistle <i>Cirsium hillii</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vii + 34 pp. |

| COMMON NAME | SCIENTIFIC NAME | SARO | COSEWIC | S-RANK | BACKGROUND SOURCES | HABITAT REQUIREMENTS | SUITABLE HABITAT IN STUDY AREA | FIELD STUDIES COMPLETED/ REQUIRED | OBSERVED BY A & A | REFERENCE |
|--------------------------|---------------------------------|------|---------|--------|---------------------|---|---|--|-------------------|--|
| Houghton's Goldenrod | <i>Solidago houghtonii</i> | THR | | | MNRF (Bruce County) | Grows on seasonally wet limestone alvars, calcareous beach sands or inter-dunal wetlands along the Great Lakes shorelines. COSEWIC 2005 | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2005. COSEWIC assessment and status report on the Houghton's goldenrod <i>Solidago houghtonii</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 17 pp. |
| Lakeside Daisy | <i>Tetraneuris herbacea</i> | THR | | | MNRF (Bruce County) | Primarily found in alvars, but occasionally occurs in prairies and cliffs. Habitat is seasonally wet in spring and fall with moderate drought-like conditions in the summer. COSEWIC 2002 | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2002. COSEWIC assessment and status report on the lakeside daisy <i>Hymenoxys heracea</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 24 pp. |
| Pitcher's Thistle | <i>Cirsium pitcheri</i> | THR | | | MNRF (Bruce County) | Found on sand dunes and sandy beaches, preferably with open, dry, loose sand with little to no vegetation immediately surrounding or shading the thistles. COSEWIC 2010. | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC. 2010. COSEWIC assessment and status report on the Pitcher's Thistle <i>Cirsium pitcher</i> in Canada. Committee on the Status of Endangered wildlife in Canada. Ottawa. x + 32 pp. |
| Tuberous Indian Plantain | <i>Arnoglossum plantagineum</i> | SC | SC | S3 | MNRF (Bruce County) | Habitat includes open, sunny areas in wet calcareous soils, including wet meadows and shoreline fens (COSEWIC 2002d). | No habitat matching criteria identified in Study Area | The Study Area was investigated for habitat during ELC and vegetation surveys. No further studies required | None observed. | COSEWIC 2002. COSEWIC assessment and update status report on the tuberous Indian-plantain <i>Arnoglossum plantagineum</i> in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. vi + 11 pp. |

References:

Cadman, M.D.,D.A. Sutherland, G.G. Beck, D. Lepage, and A.R. Couturier. 2007. The Atlas of the Breeding Birds Ontario 2001-2005. Bird Studies Canada, Environment Canada, Ontario Field Ornithologists, Ontario Ministry of Natural Resources, and Ontario Nature, Toronto,xxii + 706pp. (Available online here: <http://www.birdsontario.org/atlas/datasummaries.jsp>)

Colin Jones, Ross Layberry, and Alan Macnaughton. Ontario Butterfly Atlas Online. (April 30, 2015). (Available online here: Toronto Entomologists’ Association: http://www.ontarioinsects.org/atlas_online.htm)

Dobbyn, J. 1994. Atlas of the Mammals of Ontario. Federation of Ontario Naturalists, Altona Manitoba, Canada. (available online here: <http://www.ontarionature.org/discover/resources/publications.php>)

MNRF, 2016. Bruce County Upper Tier Species at Risk. Ministry of Natural Resources and Forestry. Provided June 20, 2016.

NatureServe. 2015. NatureServe Explorer: An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available <http://explorer.natureserve.org>. (Accessed: January 5, 2016).

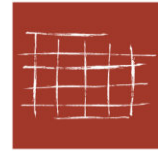
NHIC, 2015. MNRF Make a map: Natural Heritage Areas. (Available online: <http://www.ontario.ca/environment-and-energy/make-natural-heritage-area-map>)

Ontario Nature. 2015. Ontario Reptile and Amphibian Atlas: a citizen science project to map the distribution of Ontario’s reptiles and amphibians. Ontario Nature, Ontario. (Available onlnie here: <http://www.ontarionature.org/atlas>; Accessed April 29, 2015].

APPENDIX 7
Site Investigation Details

| Survey | Time | Date | Staff | Temp. (°C) | Wind (Beaufort) | Cloud Cover % | Precipitation | Past Precipitation |
|----------------------|-------------|-----------|-------|---------------|-----------------|---------------|---------------|-----------------------|
| ELC/Summer Botanical | 12:00-14:30 | 28-Jul-17 | SF | 19 | 2 | 80 | None | None |
| Fall Botanical | 07:30-10:45 | 20-Oct-17 | SF | 9 | 1 | 0 | None | None |

APPENDIX 8
MNRF Request for Information



190 Nicklin Road
Guelph, Ontario
N1H 7L5

T: 519.822.6839
F: 519.822.4052
info@aboudtng.com
www.aboudtng.com

URBAN FORESTRY
ARBORIST REPORTS
MANAGEMENT PLANS
TREE PRESERVATION PLANS
TREE RISK ASSESSMENT
GIS TREE INVENTORIES
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NATURAL SYSTEMS DESIGN
HABITAT RESTORATION
EDGE MANAGEMENT PLANS
RAVINE STEWARDSHIP PLANS
NATURALIZATION PLANS
INTERPRETIVE DESIGN
MONITORING
CONTRACT ADMINISTRATION

ENVIRONMENTAL STUDIES
SUBWATERSHED STUDIES
ENVIRONMENTAL IMPACT
STATEMENTS
ECOLOGICAL LAND
CLASSIFICATION
WETLAND EVALUATION
VEGETATION ASSESSMENT
BOTANICAL INVENTORIES
WILDLIFE SURVEYS
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MASTER PLANNING
RESIDENTIAL COMMUNITIES
COMMERCIAL/INDUSTRIAL
HEALTHCARE AND EDUCATION
STREETSCAPES
PARKS AND OPEN SPACES
TRAIL SYSTEMS
GREEN ROOFS
CONTRACT ADMINISTRATION

EXPERT OPINION
OMB TESTIMONY
LEGAL PROCEEDINGS
PEER REVIEW
RESEARCH
EDUCATION

07/07/2017

Our Project #: AA17-119A
Sent by email: MidhurstInfo@ontario.ca

Ministry of Natural Resources and Forestry
Midhurst District
2284 Nursery Road
Midhurst, ON L9X 1N8

Attention: ESA Midhurst

**Re: Riversdale Bridge No. 0002 EA, Municipality of Brockton, Bruce County
Request for Species at Risk and Local Site Information**

Dear ESA Midhurst:

Please accept this request for Information regarding:

- ☒ Species at Risk
- ☒ Wetland Mapping and/or Evaluation and Data Records [Wetland name]
- ☒ Fish Dot Information
- ☐ ANSI Mapping and/or check-sheet [ANSI name]
- ☒ Other: Any other possible site constraints or information would also be greatly appreciated.

Project Description

The existing Riversdale Bridge No. 0002 is part of Sideroad 20 West, crossing the Teeswater River in the Village of Riversdale. Information collected applies to an Environmental Impact Study for an Environmental Assessment to determine the best course of action regarding the removal, repair or replacement of the Riversdale Bridge No. 0002. Following bridge removal, bridge replacement or road re-alignment will be considered. Figure 1, attached, contains the subject area and the study area including all adjacent lands up to 120m.

The information provided will be used to inform the Terms of Reference and field program, which will be prepared consultation with the Municipality of Brockton, Saugeen Valley Conservation Authority and Bruce County.

Township: Greenock

Lot: 30

Concession: 1N

UTM Coordinates: 473054.09 4882323.40

Background Information

A thorough background search has been completed; using available resources provided online related to the subject lands and adjacent lands and is listed below:

1. The Ontario Reptile and Amphibian Atlas indicates that one species of Conservation Concern, Common Snapping Turtle (SC) has been identified within 10km of the study area.
2. The Natural Heritage Information Center indicates that of 2 species of Conservation Concern, Common Snapping Turtle (SC) and bobolink (THR) have been identified within 1km of the study area.
3. The Ontario Mammal Atlas indicates that 2 species of Conservation Concern, Little Brown Myotis (END) and Northern Myotis (END) have been identified within 10km of the study area.
4. The Ontario Breeding Bird Atlas indicates that 8 species of Conservation Concern, Eastern Wood-pewee (SC), Bank Swallow (THR), Barn Swallow (THR), Wood Thrush (SC), Golden-winged Warbler (SC), Grasshopper Sparrow (SC), Bobolink (THR) and Eastern Meadowlark (THR), have been identified within 10km of the study area.
5. A review of the Saugeen Valley Conservation Authority web mapping indicates that the bridge and surrounding study area are within the [Saugeen Valley Conservation Authority screening limit.
6. A review of the Land Information Ontario mapping (2007) indicates that part of the Greenock Swamp Provincially Significant Wetland complex is within the southern portion of the study area, while unevaluated wetlands occur throughout the centre of the study area on both sides of the road allowance.

Please contact the undersigned should you require additional information of the above.

Yours truly,

ABOUD & ASSOCIATES INC.



Shannon Ferguson, B. Env. Eco. Rest. Cert., Ecologist
T:519.822.6839 x.5

CC: Andrea Nelson, Senior Hydrogeologist, GM BluePlan
Attachment: Figure 1

S:\A+A Projects\2017\2-Approved Projects\17-119A Greenock Bridge 002 EIS\Report\Appendices\MNRF Request for Information.docx



LEGEND

- STUDY AREA
- SUBJECT AREA
- WOODLAND
- WETLAND (EVALUATED)
- WETLAND (UNEVALUATED)

Information Sources:
 1. Orthophotography provided by First Base Solutions
 Accessed July 6, 2017.
 2. Wooded Areas provided by Land Information Ontario.
 Accessed July 6, 2017.
 3. Wetlands provided by Land Information Ontario
 Accessed July 6, 2017.

STUDY AREA

Project:
**RIVERSDALE BRIDGE
 (NO. 0002)**



Date: JULY 2017
 Project: AA17-119A
 Scale: 1 : 5000

ABOUT & ASSOCIATES INC.
 Consulting Architects • Ecologists • Landscape Designers
 881 Woodbine Street, Suite 200, Ontario, Canada M1H 3K5
 416-482-6839 F 416-482-4552 info@aboutand.com www.aboutand.com

Figure No:

1

Shannon Ferguson

From: Dodge, Kathy (MNRF) <kathy.dodge@ontario.ca>
Sent: July-19-17 3:23 PM
To: Shannon Ferguson
Subject: RE: 17-119A- MNRF Request for Information July 7, 2017

Hi Shannon-

I have reviewed your information request, and again you have done a thorough search of available resources.

We do not have a lot to add.

Wetland mapping/evaluation- the wetland in the area of this bridge location is an unevaluated wetland. It is adjacent to a PSW- Greenock Swamp and appears to be hydrologically connected. The argument could be made that it should have been complexed. The Greenock Swamp PSW is a very large wetland made up of mainly treed swamp communities. If you would like a copy of the evaluation, let me know. Mapping is available through Make A Map.

Fish Dot information- We do not have any fisheries information (fish dots) for this area. Our closest sampling location is in Kinlough Creek approx., 1.5 km upstream. It has common shiners, brook stickleback and brassy minnow as species present. We consider the Teeswater River to be a cool/warm water system in this area, with known populations of smallmouth bass and northern pike.

SAR – I do not have any additional species occurrence information to add to your list. Species at risk records found in the NHIC database are not exhaustive and are based on **known** occurrences only. As a result, although there may be no record (or confirmation) of a SAR on site it does not mean that they are not present if appropriate habitat exists. Due diligence is therefore still required and would include an appropriate consideration of what species could be present based on available habitat at the noted study areas. Your field work should inform you on what species on the SARO list could possibly be encountered based on available habitats in the areas of the study and the possible survey methodologies required during your site assessments.

In addition to the species you listed, other species to consider include (but not limited to)...

Hungerford's Crawling Water Beetle (END)
Northern Long eared Bat (END)
Tri-coloured Bat (END)
Eastern Small Footed Bat (END)
Eastern Ribbon snake (SC)

The bridge should be checked for barn swallows prior to any activity. They are commonly found nesting under bridges in this area.

If you have any additional questions, please feel free to give me a call.

Kathy Dodge

Kathy Dodge

MANAGEMENT BIOLOGIST | ONTARIO MINISTRY of NATURAL RESOURCES and FORESTRY | OWEN SOUND FIELD OFFICE -MIDHURST DISTRICT

1450 7TH Ave. East, Owen Sound, ON N4K 2Z1 | PH: 519.371.8422 | FAX: 519.372.3305 | EMAIL: kathy.dodge@ontario.ca



From: Shannon Ferguson [<mailto:sferguson@aboudtng.com>]

Sent: July-07-17 9:48 AM

To: MIDHURSTINFO (MNRF)

Subject: 17-119A- MNRF Request for Information July 7, 2017

Good Morning,

Please see the attached request for information, regarding a site in the Village of Riversdale, Municipality of Brockton. If ESA Owen Sound has a form for information requests we would appreciate a copy. We have included a short letter with all pertinent information regarding the site, in lieu of a form. Any information you can provide for the site would be appreciated.

Thank you,

Shannon Ferguson B.Env. Eco. Rest. Cert.

Ecologist

MNRF Certified Wetland Evaluation . MNRF Certified Ecological Land Classification

ABOUD & ASSOCIATES INC. 190 Nicklin Road . Guelph . Ontario . N1H 7L5

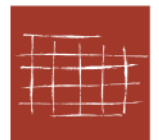
T:519.822.6839 . C : 289.686.9499 . F:519.822.4052 www.aboudtng.com . sferguson@aboudtng.com

APPENDIX 9
Barn Swallow Nesting Evidence



- Urban Forestry
- Ecological Restoration
- Landscape Architecture
- Environmental Studies
- Expert Opinion

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Prepared By:



DRAFT

Floodplain Analysis Report

Bridge No. 0002 and Sideroad 20, Village of Riversdale
Municipality of Brockton

GMBP File: 212326

February, 2018

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FIGURE 1: SITE LOCATION MAP

FIGURE 2: STUDY WATERSHED AREA

FIGURE 3: FLOOD MODEL CROSS-SECTION LOCATION PLAN

APPENDICES

APPENDIX A: SVCA CORRESPONDENCE

APPENDIX B: HYDROLOGY

APPENDIX C: FLOODPLAIN MODELING – EXISTING CONDITIONS

APPENDIX D: FLOODPLAIN MODELING – PROPOSED CONDITIONS

APPENDIX E: FLOODPLAIN MODELING – FLOW SENSITIVITY ANALYSIS

APPENDIX F: PHOTOS – EXISTING BRIDGE

**BRIDGE NO. 0002 AND SIDEROAD 20, VILLAGE OF RIVERSDALE
MUNICIPALITY OF BROCKTON**

FLOODPLAIN ANALYSIS REPORT

FEBRUARY, 2018

GMBP FILE: 212326

1. INTRODUCTION AND BACKGROUND

As part of the Municipal Class Environmental Assessment (EA) process for the aging Bridge No. 0002, located along Sideroad 20 within Lot 30, Concession 1N in the Village of Riversdale of the former Township of Greenock, three design alternatives are currently considered:

- Removal and replacement of the existing bridge;
- Removal of the existing bridge with road re-alignment of Sideroad 20; and,
- Retention of the existing bridge with road re-alignment of Sideroad 20.

Road re-alignment of Sideroad 20 would include an extension southerly to Highway 9.

The study area is located within the Saugeen Valley Conservation Authority (SVCA) Screening Area. Refer to Figure 1 for a Site Location Map. As such, the SVCA has required that the effect on the floodplain of the Teeswater River be quantified by means of a backwater analysis as referenced in a letter, dated August 18, 2003 and enclosed in Appendix A. The requirement for backwater analysis was confirmed in a more recent e-mail from the SVCA dated July 17, 2017 also enclosed in Appendix A. As requested by the SVCA, backwater analysis is to be considered for the study design alternatives during the 10, 25, 50, and 100-year Return Period storm events as well as the Regional (Hurricane Hazel) storm event. The study watershed area is shown on Figure 2, encompassing a total drainage area of approximately 415 km².

HEC-RAS computer floodplain (backwater) modeling was completed to determine water surface elevations of each alternative for comparative analysis purposes. The purpose of this report is to describe:

- i) The extent of the preliminary modeling;
- ii) The results of the comparative analysis; and,
- iii) The feasibility of implementing each design alternative.

HEC-RAS modeling was completed for the section of the Teeswater River approximately 300 m south of Highway 9, from Highway 9 to upstream of the existing Bridge No. 0002, to approximately 1.9 km downstream of Bridge No. 0002. Refer to Figure 3 for the Flood Model Cross-Section Location Plan. Since an alternative to remove and replace the existing bridge is not anticipated considerably to affect the existing geometry, the replacement alternative is considered to also be reflective of existing conditions.

2. FLOODPLAIN BACKWATER ANALYSIS AND HYDROLOGY

Preliminary HEC-RAS cross-sections were developed using publicly available resources, including Bruce County Maps (1m elevation contours) and Ontario Base Map data. Historic flows for the Teeswater River were obtained from the SVCA, as measured at a stream gauge located approximately 9.9 km downstream of Bridge No. 0002 at Bruce Road 20. The SVCA stream gauge provided data for the years 1986 to 2016. The Ontario Flow Assessment Tool (OFAT), provided by the Ministry of Natural Resources and Forestry (MNRF), and the aforementioned mapping data was used to determine watershed areas for stream gauge data transposition and hydrologic modeling of the study area.

The floodplain analysis included a Statistical Flood Frequency Analysis (FFA), enclosed in Appendix B, using the provided SVCA stream gauge data to determine the 10, 25, 50, and 100-year Return Period flows for the Teeswater River at the stream gauge location.

The drainage area of the Teeswater River to the stream gauge location is approximately 513 km². The total drainage area at the downstream end of the study modelled area, as shown on Figure 2, is approximately 415 km². The MNRF OFAT data enclosed in Appendix B provides the study watershed characterization parameters including the total drainage area. The Return Period flows determined at the stream gauge station can be transposed to the site, using ratios between discharge and drainage area; as follows:

$$Q_2 = Q_1 * (A_2/A_1)^{0.75}$$

Where: Q_2 = Instantaneous flood flow for the Teeswater River at the location of the gauge station.

Q_1 = Instantaneous flood flow for the Teeswater River at the downstream end of the modelled area.

A_2 = Area of Teeswater River Watershed at the location of the gauge station.

A_1 = Area of Teeswater River Watershed at the downstream end of the modelled area.

Therefore, the Return Period flows for the Teeswater River at the location of the gauge station, as determined by the Statistical FFA, and the Return Period flows for the Teeswater River through the subject area, as determined by the transposition calculation, are as shown in Table 1.

The HEC-RAS floodplain modeling included a flow sensitivity analysis to compare various Return Period flows. With respect to the 415 km² study watershed area, the MNRF OFAT Index Flood model and a MIDUSS hydrologic model developed by GM BluePlan was compared to the Statistical FFA flows.

The MIDUSS model was developed using intensity-duration-frequency (IDF) data per the Mount Forest IDF station (ID 6145504) for the 10 to 100-year storm events. The 24-hour SCS Type-II rainfall distribution was observed to generate conservative flows for the 10 to 100-year storm events. The full 48-hour Hurricane Hazel storm data was used for the Regional event modeling with Antecedent Moisture Condition (AMC) II. The hydrologic parameters (i.e. curve number) used in MIDUSS were developed using land cover data per the MNRF OFAT tool. Hydrologic modeling is enclosed within Appendix B. Given that the Regional (Hurricane Hazel) storm event is an actual historic storm event, the associated flow cannot be approximated using the Statistical FFA. The MIDUSS model was used to determine the design flow associated with the Regional Storm event.

The SVCA e-mail (July 17, 2017) enclosed within Appendix A noted that Greenock Creek typically flows south under Highway 9 under normal flow conditions, eventually joining the Teeswater River upstream of Riversdale, but that the creek can experience a reverse flow effect under flood conditions. If Greenock Creek overtops its banks during a flood event, the flood waters would appear to drain westerly to the Teeswater River (downstream of the Sideroad 20 Bridge No. 0002) through the lower lying lands and towards the downstream limit of the watershed area as shown on Figure 2, according to the MNRF OFAT watershed delineation. The MNRF OFAT watershed delineation appears consistent with the area topography. Refer to the topography as shown on Figure 3 which helps illustrate the creek drainage patterns. The total 415 km² watershed area used for modeling purposes, as shown on Figure 2, includes the tributary drainage area of Greenock Creek which is expected to account for the creek's contributing flow even under flood conditions.

The Statistical FFA, MNRF OFAT Index Flood and MIDUSS model flows are shown below in Table 1 for comparative purposes.

Table 1 – Return Period Storm Event Flows

| Return Period Storm Event | Instantaneous Flow at SVCA Teeswater River Gauge (m³/s) | Transposed Statistical FFA Flow for Study Area (m³/s) | MNRF OFAT Index Flood (m³/s) | MIDUSS Model (m³/s) |
|----------------------------------|---|---|--|---------------------------------------|
| 10-year | 77.1 | 66.6 | 103.7 | 295.1 |
| 25-year | 91.5 | 79.0 | 129.5 * | 357.9 |
| 50-year | 102.4 | 88.4 | 152.4 | 407.0 |
| 100-year | 113.3 | 97.8 | 175.7 | 458.5 |
| Regional | N/A | N/A | N/A | 734.5 |

* Interpolated value as MNRF OFAT Index Flood model does not include a 25-year value.

The MIDUSS model appeared to generate highly conservative Return Period flows for the 10 to 100-year events when compared to the other flows, attributed to the MIDUSS model being more suited for modeling drainage areas of a lesser scale or with more detailed sub-catchment delineation. The Regional flow generated by MIDUSS was compared to the Regional flow determined in the Teeswater Floodplain Mapping Study (MMM Group, February 2017). The Teeswater Floodplain Mapping Study involved a total drainage area of 127 km² with a determined Regional flow of 266.5 m³/s. Using the transposition equation as previously noted in this report, with the Teeswater study drainage area and Regional flow, the Regional flow for this study's drainage area (415 km²) can be estimated to be 647.7 m³/s. Therefore, the MIDUSS model was deemed to be generating a comparable, although conservative, Regional flow of 734.5 m³/s.

Should the project reach the detailed design stage at a later time, the study hydrology may be further refined to generate flows for detailed design. Nevertheless, the MIDUSS flows determined per this report would be more conservative and may be sufficient for detailed design.

The subcritical flow regime was applied for the HEC-RAS modelled reach of the Teeswater River given the relatively flat channel gradient. The HEC-RAS modeling computed Froude numbers of less than 1 in all cases which confirmed the subcritical flow regime. Given that no existing flood modeling was available in the study area, the normal depth boundary condition was applied within the HEC-RAS modeling, using a slope of 0.001 m/m (flat channel gradient) at the downstream limit of the modelled area and kept consistent throughout the modeling for all Return Period flows and design alternative conditions. Therefore, the computed water surface elevations, within the modelled reach upstream of the boundary condition, are considered appropriate for comparative analysis between existing conditions and the proposed design alternatives.

The low flow channel of the river was modelled with a Manning's roughness (n) value of 0.035 within HEC-RAS based on the values listed within the current HEC-RAS Reference Manual and the observed Teeswater River characteristics. Overbank Manning's roughness (n) values ranged from 0.040 to 0.100 to reflect the various land covers in the study area of agricultural and woodlands. Detailed stationing was appropriately measured for all cross-sections to model the variable land cover types as accurately as possible within HEC-RAS.

The HEC-RAS structure modeling of the Highway 9 bridge and Sideroad 20 bridge (No. 0002), including road deck profiles and channel bank elevations in the vicinity of the bridges, was based on a field survey completed by GM BluePlan on November 17, 2017. Existing bridge photos are enclosed within Appendix F. Contraction and expansion coefficients of 0.3 and 0.5, respectively, were applied for the cross-sections binding the bridges, consistent with the current HEC-RAS Reference Manual. Contraction and expansion coefficients of 0.1 and 0.3, respectively, were applied for all other cross-sections experiencing gradual flow transitions. Ineffective flow areas were modelled for the structures as appropriate and consistent with the current HEC-RAS Reference Manual.

3. BACKWATER ANALYSIS RESULTS AND DISCUSSION

Preliminary HEC-RAS modeling was completed for the full range of Return Period flows as listed above in Table 1. The HEC-RAS profile and cross-sectional plots for existing conditions, and for the proposed design alternatives, are enclosed in Appendix C and D respectively. The HEC-RAS plots in Appendix C and D are based on the MNRF OFAT Index Flood model for the 10 to 100-year Return Period flows as it was deemed to provide a mid-range of flows when compared to the conservatively generated MIDUSS flows and the lower Statistical FFA flows. Nevertheless, the full range of flows in Table 1 was assessed through a flow sensitivity analysis of the HEC-RAS model. It was observed through the flow sensitivity analysis that, on occasion, negligible 1 cm water surface elevation changes occurred for the full range of design flows, consistent with the results shown below in Table 2. Refer to Appendix E for the HEC-RAS Output Tables of the flow sensitivity analysis. The negligible differences in water surface elevations are discussed later in this report. The Regional flow in all HEC-RAS modeling is based on the MIDUSS generated flow as previously discussed in this report (Statistical FFA cannot be used for Regional flow).

The Regional event water surface elevations for the design alternatives, based on preliminary modeling, are summarized in Table 2 below. Refer to Figure 3 for the Flood Model Cross-Section Location Plan which illustrates the cross-section locations and ID numbers.

Table 2 – HEC-RAS Floodplain Model Water Surface Elevations (m)

| Regional (Hurricane Hazel) Storm Event | | | | | |
|--|---------------------------------------|---|---|---|---|
| Cross-Section ID No. | Location of Station | Bridge Removal and Replacement (Existing Conditions) (m) | Bridge Removal and Road Re-Alignment (Proposed Conditions) HEC-RAS Plan "PR" (m) | Bridge Retention and Road Re-Alignment (Proposed Conditions) HEC-RAS Plan "PR 2" (m) | Design Alternatives Difference from Existing (m) |
| 124 | U/S of Highway 9 | 275.99 | 275.99 | 275.99 | 0 |
| 123 | | 275.99 | 275.99 | 275.99 | 0 |
| 122 | | 275.98 | 275.98 | 275.98 | 0 |
| 121 | | 275.97 | 275.97 | 275.97 | 0 |
| 120 | Immediately U/S of Highway 9 Bridge | 275.91 | 275.91 | 275.91 | 0 |
| 119 | Immediately D/S of Highway 9 Bridge | 275.29 | 275.30 | 275.30 | +0.01 |
| 118 | Between Highway 9 and Bridge No. 0002 | 275.28 | 275.29 | 275.29 | +0.01 |
| 117 | | 275.25 | 275.26 | 275.26 | +0.01 |
| 116 | | 275.17 | 275.17 | 275.17 | 0 |
| 115 | | 275.15 | 275.15 | 275.15 | 0 |
| 114 | Immediately U/S of Bridge No. 0002 | 275.14 | 275.14 | 275.14 | 0 |
| 113 | Immediately D/S of Bridge No. 0002 | 275.14 | 275.14 | 275.14 | 0 |
| 112 | D/S of Bridge No. 0002 | 275.14 | 275.14 | 275.14 | 0 |
| 111 | | 275.13 | 275.13 | 275.13 | 0 |
| 110 | | 275.13 | 275.13 | 275.13 | 0 |
| 109 | | 275.12 | 275.12 | 275.12 | 0 |
| 108 | | 275.12 | 275.12 | 275.12 | 0 |
| 107 | | 275.11 | 275.11 | 275.11 | 0 |
| 106 | | 275.08 | 275.08 | 275.08 | 0 |
| 105 | | 274.99 | 274.99 | 274.99 | 0 |
| 104 | | 274.88 | 274.88 | 274.88 | 0 |
| 103 | | 274.72 | 274.72 | 274.72 | 0 |
| 102 | | 274.65 | 274.65 | 274.65 | 0 |
| 101 | | 274.55 | 274.55 | 274.55 | 0 |
| 100 | | 274.44 | 274.44 | 274.44 | 0 |

From the above table, it is generally concluded that water surface elevations upstream of the existing Bridge No. 0002 location, and within the modelled study area, would negligibly be affected by either of the design alternatives. Furthermore, water surface elevations downstream of the existing Bridge No. 0002 location, and within the modelled area, are typically unchanged by either of the design alternatives.

The HEC-RAS generated floodplain downstream of the existing Bridge No. 0002 is significantly wide (i.e. approximately 2.3 km wide at cross-section No. 113 in the Regional event, and 1.3 km wide at cross-section No. 113 for the 10-year MNRF OFAT event). The floodplain downstream of the existing Bridge No. 0002 was determined to be significantly wide for all modelled cross-sections from No. 113 to No. 100. The observed water surface elevation trends, showing negligible to no differences, are considered to be generally attributed to the significant width of the downstream floodplain when compared to the relatively narrow Bridge No. 0002 width and Sideroad 20 re-alignment geometry.

The relatively small geometry changes associated with the design alternatives, including an extension of Sideroad 20, have a negligible impact on the study area floodplain dynamics given the significantly widespread floodplain downstream and in the vicinity of Riversdale. For the proposed conditions design alternatives, it was observed per the HEC-RAS model (see Appendix D) that the top of the re-aligned road would not be submerged in the Regional event (even based on the conservative MIDUSS generated Regional flow). Flood water surface elevations downstream of the existing Bridge No. 0002 location would typically be unchanged between the existing condition and the proposed conditions, since the channel geometry and flows would remain unchanged downstream of Bridge No. 0002.

4. CONCLUSION

In conclusion, based on the results of the preliminary backwater analysis, either of the design alternatives would be feasible for implementation as water surface elevations are expected to be generally unchanged or negligibly increased from existing conditions. Accordingly, all of the design alternatives should continue to be considered as part of the EA process.

All of which is respectfully submitted,

GM BLUEPLAN ENGINEERING LIMITED

Prepared by:

Reviewed by:

DRAFT

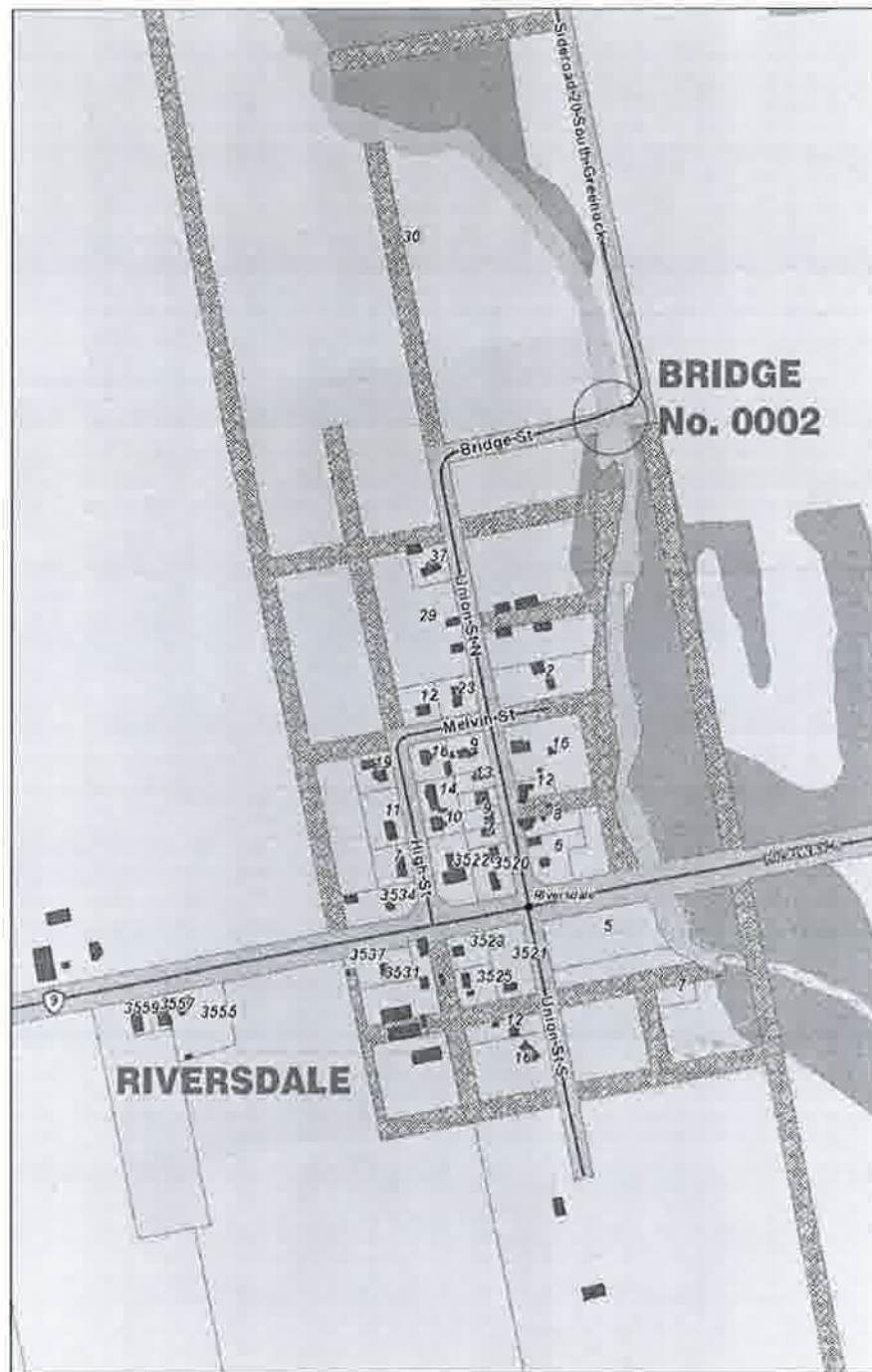
DRAFT

Oliver Dautre, B.Eng.

John Slocombe, P.Eng.

FIGURES:

Municipality
of
Brockton



SITE
LOCATION
MAP

Figure No. 1



JOB NUMBER
212526
01/2018



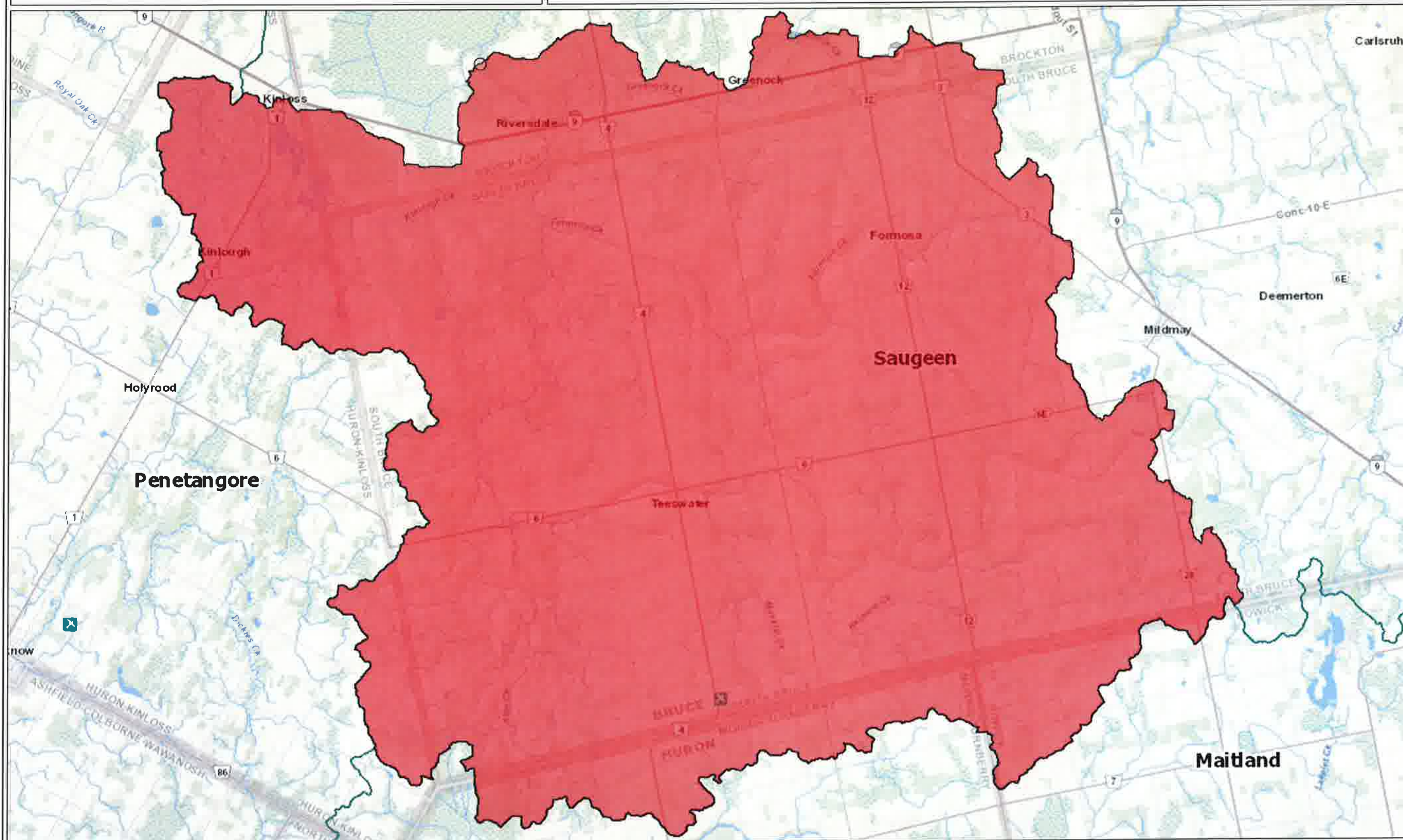
Ontario

MINISTRY OF NATURAL RESOURCES AND FORESTRY

Ontario Flow Assessment Tools

Figure 2 - Study Watershed Area

Notes:



Legend

- Assessment Parcel
 - Secondary Watershed
 - Tertiary Watersheds
 - Great Lakes - St. Lawrence Basin
 - Hudson - James Bay Basin
 - Nelson River Basin
 - Diversions
 - Waterbody Outlet
 - Conservation Authority Dam
 - Provincial Dam
 - Federal Dam
 - OPG Dam
 - Other Dam
 - HYDAT Gauge
 - HYDAT Gauge (RBNH)
- Land Cover Compilation
- Other
 - Cloud/Shadow
 - Clear Open Water
 - Turbid Water
 - Shoreline
 - Mudflats
 - Marsh
 - Swamp
 - Fen
 - Bog
 - Heath
 - Sparse Treed
 - Treed Upland
 - Deciduous Treed
 - Mixed Treed
 - Coniferous Treed
 - Plantations - Treed Cultivated
 - Hedge Rows
 - Disturbance
 - Open Cliff and Talus
 - Alvar
 - Sand Barren and Dune
 - Open Tallgrass Prairie
 - Tallgrass Savannah
 - Tallgrass Woodland
 - Sand/Gravel/Mine
 - Tailings/Extraction
 - Bedrock
 - Community/Infrastructure
 - Agriculture and Undifferentiated Rural Land Use

5.3 0 km 2.64 5.3

Scale: 1 : 103,878

Projection: Web Mercator

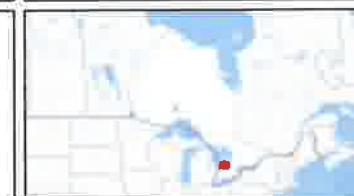


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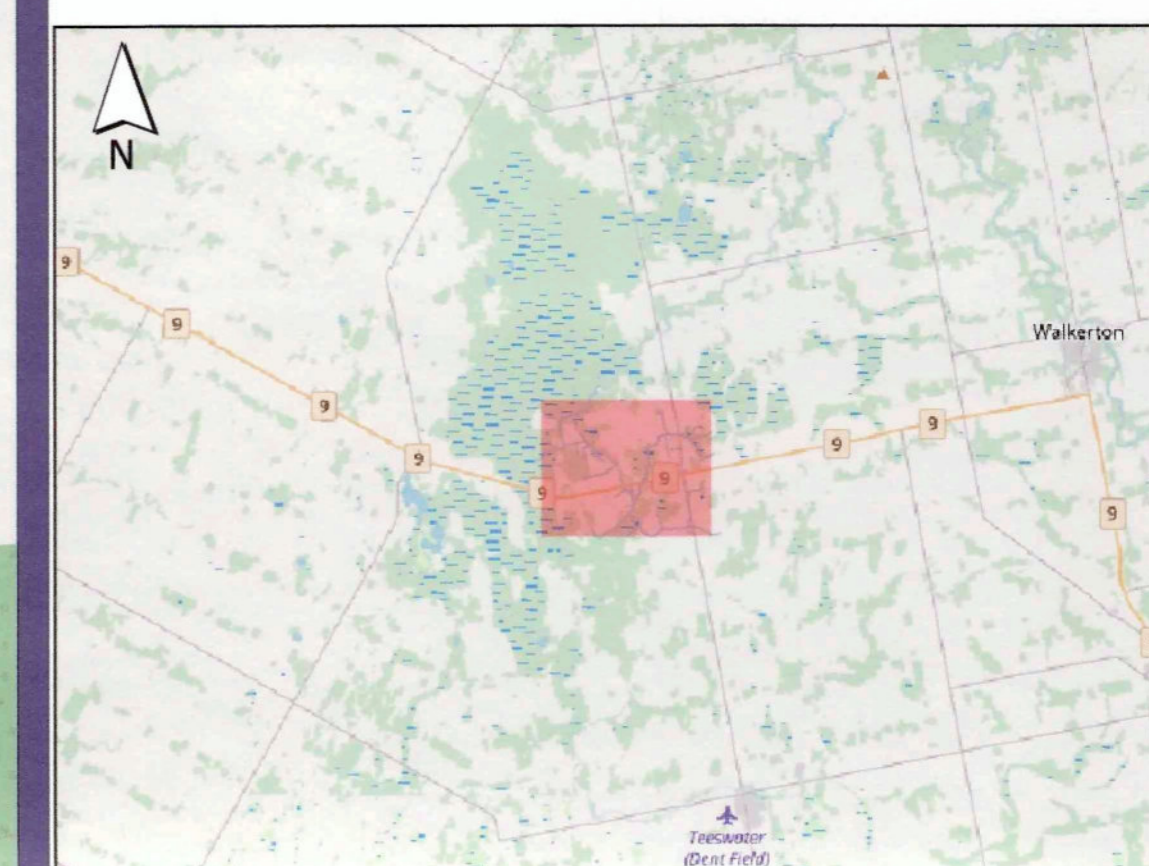




Riversdale Bridge - Municipality of Brockton

Figure 3 - Flood Model Cross-Section Location Plan

- 124 Flood Model (HEC-RAS) Cross-section
- 1m Elevation Contours
- Roads
- Forest / Woodlands



SCALE = 1:7,500

(c) Open Street Maps and Contributors

APPENDIX A: SVCA CORRESPONDENCE



261123 Concession 18
Twp. of West Grey
(former Normanby Twp.)

Mailing Address:
R.R. 1, Hanover, ON
N4N 3B8 Canada

Tel 519-364-1255
Fax 519-364-6990
www.svca.on.ca
publicinfo@svca.on.ca

FILE COPY

* See GI
11/07/1986 ✓

Lot 30 + 31

August 18, 2003

Con INDR

Gree

SCANNED

FEB 02 2017

Saugeen Conservation

61
08/18/03
Gree
FAXED
11/18/03

East of
Riversdale

Gamsby and Mannerow Limited
652 Third Avenue East
Owen Sound, ON
N4K 2K1

ATTENTION: J. V. Dowdall, C.E.T.

Dear Mr. Dowdall:

RE: Sideroad 20 Extension
Former Township of Greenock
Municipality of Brockton

In response to your correspondence of July 21, 2003, the Saugeen Valley Conservation Authority offers the following comments. Given that the original comments for this proposed road project were provided by the SVCA almost 17 years ago, the following comments replace that previous letter.

1. The Teeswater River is subject to the federal *Fisheries Act*, as fish habitat is present. Also, there may be small field ditches or intermittent channels within the project area that might exhibit fish habitat. Section 35 of the *Fisheries Act* prohibits the harmful alteration, disruption, or destruction of fish habitat unless authorization is given by the Minister of Fisheries and Oceans, subject to appropriate terms and conditions.

As you are aware, the SVCA has a Level 2 Fish Habitat Management Agreement with Fisheries and Oceans Canada, Ontario - Great Lakes Area, through which the SVCA reviews projects for potential impacts on fish habitat on behalf of DFO. In the SVCA's opinion this project may affect fish habitat; therefore, we advise you to contact DFO to obtain their comments.

From the Authority's preliminary review of this proposal, there are at least five aspects of this project that may be of concern from a fish habitat standpoint. One, the west side of the road bed in the vicinity of the existing bridge will be encroaching into the river. Two, most of the new road will be located in an area that is seasonally flooded and such flooded areas are typically used by

Conservation
Through
Cooperation



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CONSERVATION
ONTARIO NETWORK

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Northern Pike for spawning. Three, the ditches or intermittent channels might be altered. Four, loss of riparian vegetation. Five, removal of the existing bridge could cause an effect on habitat if not done appropriately. One or more of these impacts may cause a loss of habitat, which means DFO authorization will be necessary.

For this project you should obtain any further comments on the *Fisheries Act* directly from DFO, and not the SVCA, unless they indicate otherwise.

2. As mentioned in the Authority's comments in 1986, the new road will alter the flood plain to some extent. We are aware that the road elevation will generally be no higher than 901.0 feet, that two relief culverts are included, and in 1986 you indicated no buildings would be affected. Nevertheless, the SVCA will require that you quantify the effect on the flood plain by means of a backwater analysis.

The analysis should use an appropriate computer model (e.g. HEC-2) to calculate river flood levels for the existing and proposed state for the 10, 25, 50, and 100 year events and the Regional Storm flood.

3. As this project will involve the construction of an entirely new road, perhaps the Class Environmental Assessment for Municipal Road Projects is applicable? The SVCA does not administer the EA legislation but we would like your comments on this item.
4. This general area typically experiences flooding at least on an annual basis and flood water can stay elevated for a number of days. Construction activity should be timed to avoid the likelihood of flooding. However, while the flooding here is usually a spring time occurrence, it can happen at any time. Accordingly, construction operations should be organized to minimize its exposure to flooding. For example, equipment and materials should be stored above the flood elevation.
5. The Authority will require information on the intended removal and site restoration procedures for the existing bridge, if removal is proposed.
6. A permit under the SVCA's Alteration to Waterways regulations (Revised Regulations of Ontario 169/90) will be required. Before submitting an application to this office, the Authority suggests that you address the design issues raised in this letter, and any issues arising from other agencies, before formally applying for a permit.

Gamsby and Mannerow Limited
August 18, 2003
Page 3

Should questions arise, do not hesitate to contact this office.

Yours sincerely,

A handwritten signature in black ink, appearing to read "Gary Senior". The signature is fluid and cursive, with the first name "Gary" and last name "Senior" clearly distinguishable.

Gary Senior, Manager
Environmental Planning and Regulations

GS/

cc: Derrick Moggy, Fish Habitat Biologist, DFO, Harvester Road, Burlington
Roland Anstett, Director, SVCA

Drea Nelson - GM BluePlan

From: Gary Senior <G.Senior@SVCA.ON.CA>
Sent: Monday, July 17, 2017 10:00 AM
To: John Slocombe - GM BluePlan; Drea Nelson - GM BluePlan; Michelle Gallant
Subject: Re: 212326 Bridge No 0002, Greenock: Hydrological Considerations

Hello John,

In response to your email of July 10, 2017 and Drea Nelson's email of June 30, 2017, SVCA staff offers the following comments.

At the outset, these comments are in regard to hydrological information only, as other staff will be conducting the review of this project and handling matters relating to SVCA Regulation 169/06, as amended.

I am not aware of any engineered floodline mapping for this area.

There have been a couple of occasions over the last thirty years or so when this project was proposed. Gamsby and Mannerow Ltd. was the consultant on both occasions, so I assume you have access to those files. The SVCA's last correspondence was on August 18, 2003. If you do not have that letter on file, we can email it to you. That letter includes some items that are now out-of-date, but one item recommends a flood plain (backwater) analysis be undertaken. That recommendation remains in effect.

The SVCA has a stream gauge station on the Teeswater River at Bruce Road 20, downstream of the subject site. The historical flow data can be made available to you upon request. Water Survey of Canada has a stream gauge in the community of Teeswater, upstream of the site.

Perhaps a complicating factor from a hydrological perspective is the nearby Greenock Creek, which crosses under Highway 9 just east of Riversdale. Under normal flow conditions Greenock Creek flows south under Highway 9 and joins the Teeswater River just upstream of Riversdale. Under flood conditions, the Teeswater River overtops its banks and can send some of its flow up the Greenock Creek channel, in effect causing a reverse flow condition for that creek. Typical flooding does cover a broad area, and hydrologic modelling for the Teeswater River alone may be insufficient, as Greenock Creek does contribute as well.

MTO replaced the bridge over Greenock Creek in 1986. The SVCA does not have an MTO hydrological report for that project, given the opening size didn't change and no historical hydrological problems were identified. However, you could check with MTO in case such a report was done. Although the value of a report from 1986 would be limited.

Regards,

Gary Senior,
Sr. Manager Flood Warning and Land Management
Saugeen Conservation
1078 Bruce Road 12, P.O. Box 150
Formosa, ON N0G 1W0
(519) 367-3040 ext. 234

(519) 367-3041 fax
g.senior@svca.on.ca

From: John Slocombe - GM BluePlan <John.Slocombe@gmblueplan.ca>
Sent: July 10, 2017 3:07:14 PM
To: Gary Senior
Cc: Erik Downing
Subject: 212326 Bridge No 0002, Greenock: Hydrological Considerations

Hi Gary,

Just following up on the following e-mail.

I was hoping to get a sense from the SVCA perspective of the alternative to eliminate the "Bridge Street" bridge and run Sideroad 2 straight to Highway 9.

Although I suspect there is a reason that the bridge was built instead of the road "back in the day", from a flood plain perspective, at first glance, it seems there may be potential for improvement if the existing approach fills were to be removed across the river.

Do you have existing flood line mapping / modeling?

Any thoughts on whether or not updated modeling would be necessary?

Appreciate any input.

Thanks.

John Slocombe, P.Eng.
Branch Manager, Vice President

GM BluePlan Engineering Limited
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 | c: 519.372.4600
john.slocombe@gmblueplan.ca | www.gmblueplan.ca



From: Drea Nelson - GM BluePlan
Sent: Friday, June 30, 2017 12:06 PM
To: g.senior@svca.on.ca; jstrader@brockton.ca
Cc: John Slocombe - GM BluePlan; Brent Willis - GM BluePlan
Subject: 212326 Bridge No 0002, Greenock: Hydrological Considerations

Gary and John,

We have been retained by the Municipality of Brockton to complete an Environmental Assessment process for an aging bridge in the Village of Riversdale. More specifically Bridge No. 0002 which is located within Lot 30, Concession 1N in the former Township of Greenock. The subject bridge is part of Bridge Street and crosses the Teeswater River, where shown in the attached Figures. The structure is a steel through truss bridge and is supported by concrete abutments and wingwalls with an overall span of 37.1 meters. Several photos are attached for your reference.

At this time it is anticipated that the existing bridge will be removed. Following bridge removal, bridge replacement or road re-alignment will be considered (i.e. the extension of Sideroad 20 directly south to Highway 9). A review of the SVCA 169/06 Mapping (Sheet No. 584) indicates that the study area, including the area being considered for the road re-alignment, is situated within an SVCA screening area. Based on a review of available mapping (i.e. topographic contours, significant wetlands and zoning), it appears that the extensive screening area likely pertains to a floodplain. In consideration of the potential road re-alignment, we are requesting whether you are aware of any additional

floodplain/flood-hazard mapping and/or information for this area (i.e. Riversdale), more specifically the area to the east of the river and in the vicinity of the Right-of-Way and the Bridge (refer to attached Figures)?

Let me know if you have any questions,

Regards,
Andrea

Andrea Nelson, M.Sc.
Senior Hydrogeologist

GM BluePlan Engineering Limited
1260-2nd Avenue East | Owen Sound ON N4K 2J3
t: 519.376.1805 | c: 519.372.4678
andrea.nelson@gmblueplan.ca | www.gmblueplan.ca



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APPENDIX B: HYDROLOGY

Statistical Flood Frequency Analysis (FFA)
MNRF OFAT Data
MIDUSS Model

Statistical Flood Frequency Analysis (FFA)

Brockton Bridge No. 0002

Side Road 20, Riversdale, ON

Project Number: 212326

October 2017

Flow Gauge Data Provided by SVCA

Gauge Location: Teeswater River at Bruce Road 20

| Year Recorded | Maximum Instantaneous Discharge (m ³ /s) | Rank | Return Period | Data Plot | |
|---------------|--|------|---------------|-----------|-------|
| | | | | x | y |
| 2014 | 86.079 | 1 | 32.00 | 32.000 | 86.08 |
| 1988 | 84.333 | 2 | 16.00 | 16.000 | 84.33 |
| 2008 | 79.048 | 3 | 10.67 | 10.667 | 79.05 |
| 2016 | 70.630 | 4 | 8.00 | 8.000 | 70.63 |
| 2007 | 69.745 | 5 | 6.40 | 6.400 | 69.75 |
| 2009 | 69.385 | 6 | 5.33 | 5.333 | 69.39 |
| 1987 | 69.302 | 7 | 4.57 | 4.571 | 69.30 |
| 2004 | 63.294 | 8 | 4.00 | 4.000 | 63.29 |
| 1986 | 62.610 | 9 | 3.56 | 3.556 | 62.61 |
| 2001 | 60.640 | 10 | 3.20 | 3.200 | 60.64 |
| 1990 | 59.056 | 11 | 2.91 | 2.909 | 59.06 |
| 1989 | 58.168 | 12 | 2.67 | 2.667 | 58.17 |
| 1997 | 57.736 | 13 | 2.46 | 2.462 | 57.74 |
| 2006 | 56.104 | 14 | 2.29 | 2.286 | 56.10 |
| 1993 | 55.552 | 15 | 2.13 | 2.133 | 55.55 |
| 2013 | 55.240 | 16 | 2.00 | 2.000 | 55.24 |
| 2000 | 53.726 | 17 | 1.88 | 1.882 | 53.73 |
| 1998 | 53.544 | 18 | 1.78 | 1.778 | 53.54 |
| 2003 | 52.680 | 19 | 1.68 | 1.684 | 52.68 |
| 2002 | 51.883 | 20 | 1.60 | 1.600 | 51.88 |
| 2011 | 50.587 | 21 | 1.52 | 1.524 | 50.59 |
| 2005 | 48.949 | 22 | 1.45 | 1.455 | 48.95 |
| 1995 | 48.744 | 23 | 1.39 | 1.391 | 48.74 |
| 1991 | 48.061 | 24 | 1.33 | 1.333 | 48.06 |
| 1996 | 47.948 | 25 | 1.28 | 1.280 | 47.95 |
| 1994 | 47.743 | 26 | 1.23 | 1.231 | 47.74 |
| 1992 | 46.014 | 27 | 1.19 | 1.185 | 46.01 |
| 2010 | 44.624 | 28 | 1.14 | 1.143 | 44.62 |
| 2012 | 30.309 | 29 | 1.10 | 1.103 | 30.31 |
| 2015 | 27.893 | 30 | 1.07 | 1.067 | 27.89 |
| 1999 | 20.587 | 31 | 1.03 | 1.032 | 20.59 |

Statistical Flood Frequency Analysis (FFA)

Brockton Bridge No. 0002

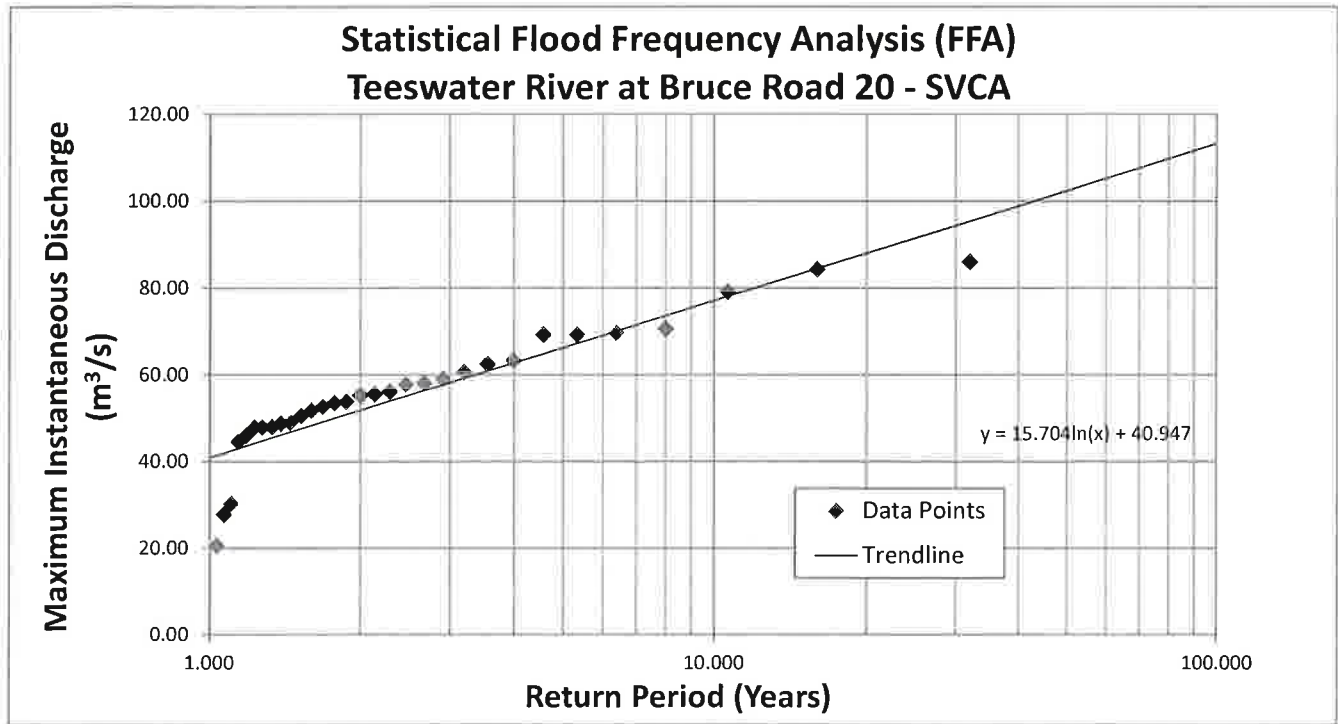
Side Road 20, Riversdale, ON

Project Number: 212326

October 2017

Data Provided by SVCA

Gauge Location: Teeswater River at Bruce Road 20



| Return Period | Instantaneous Flow at SVCA Gauge (m^3/s) | Design Flow for Modelled Study Area (m^3/s) |
|---------------|--|---|
| 10 | 77.11 | 66.61 |
| 25 | 91.50 | 79.04 |
| 50 | 102.38 | 88.44 |
| 100 | 113.27 | 97.84 |

MNRF OFAT Tool – Study Watershed Area Characterization



MINISTRY OF NATURAL RESOURCES AND FORESTRY ONTARIO FLOW ASSESSMENT TOOL

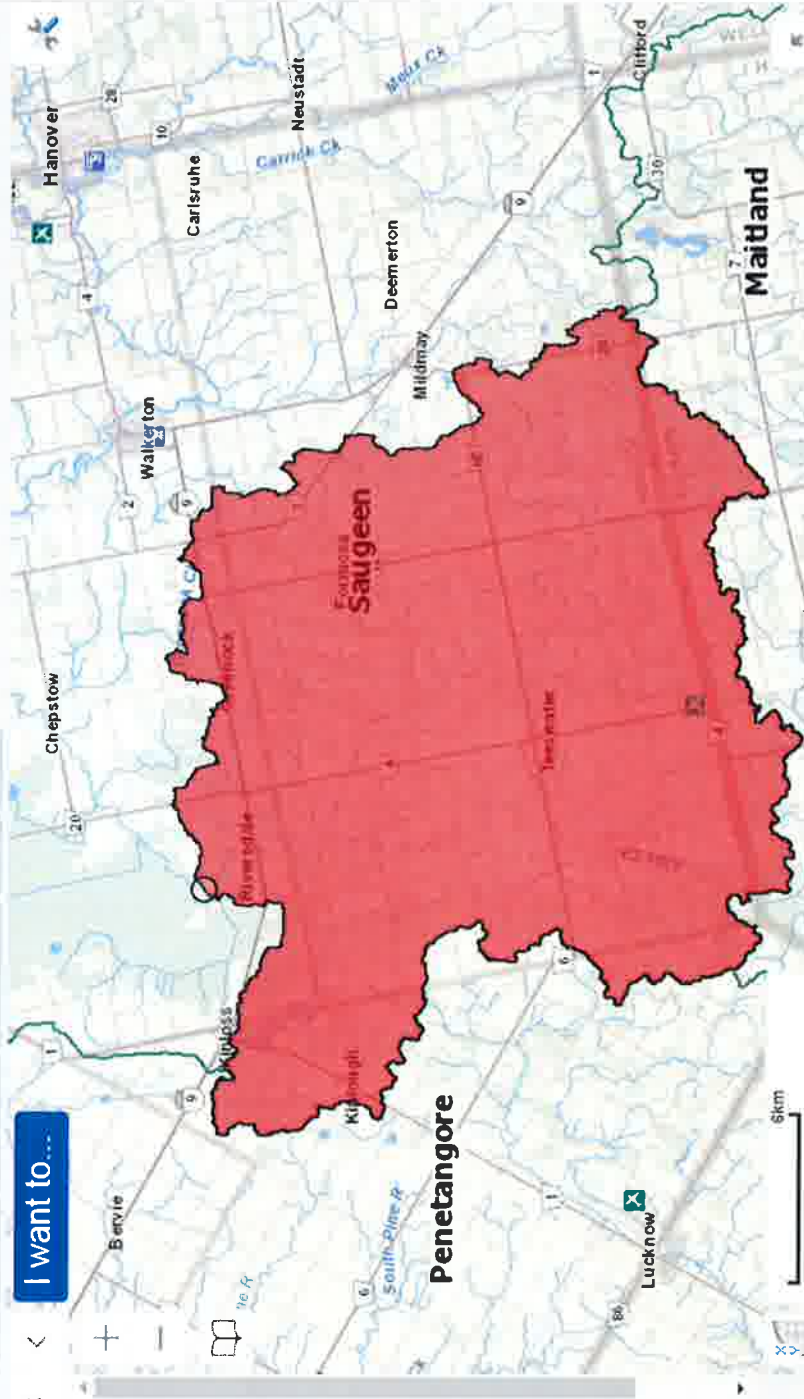
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Watershed Characterization

| | |
|--|----------|
| Drainage Area (km ²) | 415.431 |
| Shape Factor (I) | 11.947 |
| Length of Main Channel (km) | 70.451 |
| Maximum Channel Elevation (m) | 383.120 |
| Minimum Channel Elevation (m) | 268.960 |
| Slope of Main Channel (m/km) | 1.620 |
| Slope of Main Channel (%) | 0.162 |
| Area Lakes/Wetlands (km ²) | 80.492 |
| Area - Lakes (km ²) | 2.214 |
| Area - Wetlands (km ²) | 78.278 |
| Mean Elevation (m) | 310.456 |
| Maximum Elevation (m) | 385.636 |
| Mean Slope (%) | 2.992 |
| Annual Mean Temperature (°C) | 7.033 |
| Annual Precipitation (mm) | 1104.000 |

Calculate All



MNRF OFAT – Flood Flow: Index Flood Method with EPA (Moin & Shaw 1985)

[Français]



MINISTRY OF NATURAL RESOURCES AND FORESTRY
ONTARIO FLOW ASSESSMENT TOOL

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Hydrology Models

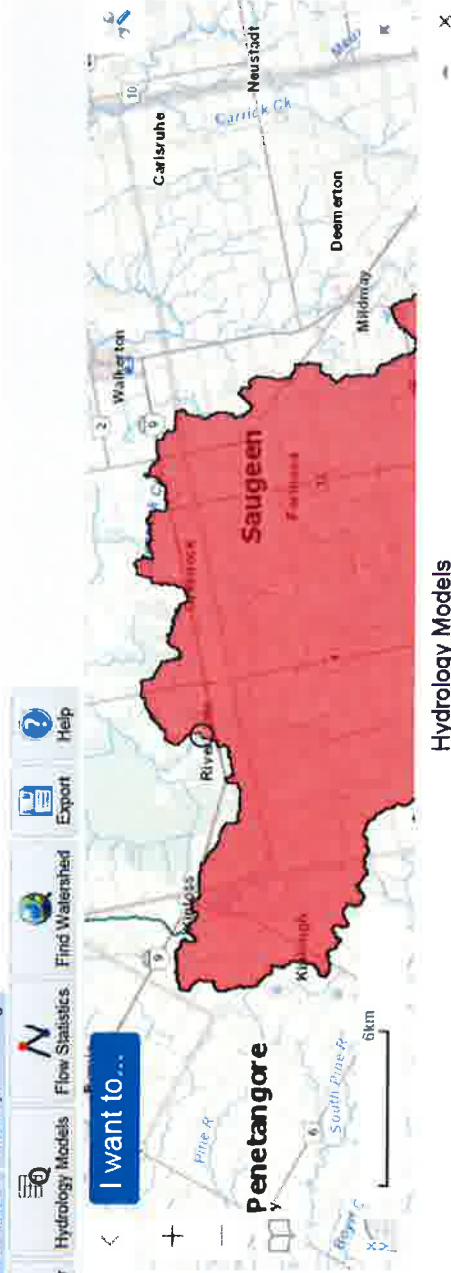
Hydrology Models Limitations

Please note that each model in OFAT has its own limitations. Please refer to the original model document, or if necessary, a practicing water professional, before using generated flow values for any decision making purpose.

| | |
|--|------------------------------|
| Mean Annual Flow (MNR 2003) | View Results |
| Low Flow: Graphical Index Method (MOEE 1995) | View Results |
| Low Flow: Regression Method (MOEE 1995) | View Results |
| Flood Flow: Index Flood Method with EPA (Moin & Shaw 1985) | View Results |
| Flood Flow: Primary Multiple Regression (Moin & Shaw 1985) | View Results |

Run All Models

| Watershed Name | On/Off | Delete |
|----------------|-------------------------------------|-------------------------------------|
| Watershed 1 | <input checked="" type="checkbox"/> | <input checked="" type="checkbox"/> |



Hydrology Models

Flood Flow: Index Flood Method with EPA (Moin & Shaw 1985)

| Flow | Results (m ³ /s) |
|-------------------|---|
| Areal limit | Drainage Area Parameter in range for model. |
| Q _{1.25} | 62.42 |
| Q ₂ | 63.5 |
| Q ₅ | 83.63 |
| Q ₁₀ | 103.7 |
| Q ₂₀ | 124.9 |
| Q ₅₀ | 152.4 |
| Q ₁₀₀ | 175.7 |
| Q ₂₀₀ | 198.95 |
| Q ₅₀₀ | 227.52 |

```

34 MIDUSS Output ----- 212326 - 10 - OD - Jan18.Out
35 MIDUSS version Version 2.25 rev. 473
36 MIDUSS created Sunday, February 07, 2010
37 Units used: is METRIC
38 Job Folder: C:\MIDUSS\RIVERSDALE\MIDUSS
39 Output filename: 212326 - 10 - OD - Jan18.out
40 Licensee name: DeleteMe
41 Company: Hewlett-Packard Company
42 Date & time last used: 1/29/2018 at 10:42:20 AM
43
44 TIME PARAMETERS
45 31 5.000 Time Step
46 1440.000 Max. Storm Length
47 4800.000 Max. Hydrograph
48
49 STORM MASS CURVE
50 32 3 Mass Curve
51 71.000 Rainfall depth
52 1440.000 Duration
53
54 II storm
55 48 C:\Program Files (x86)\MIDUSS\SCS_Type2_24hr.mrd SCS 24 hour Type
56
57 Maximum intensity 86.905 mm/hr
58 Total depth 71.000 mm
59
60 CATCHMENT 100
61 6 010hvd Hydrograph extension used in this file"
62
63 2 Rectangular
64 3 Specify values
65 SCS method
66 1
67 TOTAL
68 100
69 % Impervious
70 2.600
71 Total Area
72 41543.000
73 Flow length
74 25886.000
75 Overland Slope
76 3.000
77 Pervious Area
78 40462.883
79 Pervious length
80 25886.000
81 Pervious slope
82 3.000
83 Impervious Area
84 1080.118
85 Impervious length
86 5.000
87 Impervious slope
88 2.000
89 Pervious Manning "n"
90 0.370
91 Pervious SCS Curve No.
92 68.300
93 Pervious Runoff coefficient
94 0.244
95 Pervious Ia/S coefficient
96 0.100
97 Pervious Initial abstraction
98 11.789
99 Pervious Manning "n"
100 0.013
101 Impervious SCS Curve No.
102 98.000
103 Impervious Runoff coefficient
104 0.925
105 Impervious Ia/S coefficient
106 0.100
107 Impervious Initial abstraction
108 295.102
109
110 Catchment 100 Pervious 0.000 c.m./sec"
111 Surface Area 40462.883 Impervious Total Area "
112 Time of concentration 1211.488 1080.118 41543.000 Hectare"
113 Time to Centroid 2133.280 750.195 1100.252 minutes"
114 Rainfall depth 71.000 71.000 2006.234 mm"
115 Rainfall volume 2872.8645 76.6884 2949.5530 ha-m"
116 Rainfall losses 53.674 5.347 52.418 mm"
117 Runoff depth 17.326 65.653 18.582 mm"
118 Runoff volume 701.0498 771.9607 ha-m"
119 Runoff coefficient 0.244 0.925 0.262
120 Maximum flow 35.899 257.696 295.102 c.m./sec"
121 HYDROGRAPH Add Runoff "
122 4 Add Runoff "
123
124 START/RE-START TOTALS 100" 0.000 0.000"
125
126 Page 1

```

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3 Runoff Totals on EXIT"
4 Total Catchment area 41543.000 hectare"
5 Total Impervious area 1080.118 hectare"
6 Total % Impervious 2.600"
7 EXIT"

```

```

212326 - 25 - OD - Jan18.Out
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Output Filename: DeleteMe
Licensee name: Hewlett-Packard Company
Company: 1/29/2018 at 10:39:43 AM
Date & Time last used:

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31 $,000 Time Step
1440,000 Max. storm length"
4800,000 Max. Hydrograph"
32 STORM Mass Curve"
3 Mass Curve"
82,400 Rainfall depth"
1440,000 Duration"
48 C:\Program Files (x86)\MIDUSS\SCS_Type2_24hr.mrd SCS 24 hour Type

II storm"
Maximum intensity 100.858 mm/hr"
Total depth Hydrograph extension used in this file"
6 025hyd 82,400 mm"
CATCHMENT 100"
2 Rectangular"
3 Specify values"
1 SCS method"
100 TOTAL
2,600 % Impervious"
41543,000 Total Area"
25886,000 Flow length"
3,000 Overland Slope"
40462,883 Pervious Area"
25886,000 Pervious length"
3,000 Pervious slope"
1080,118 Impervious Area"
5,000 Impervious length"
2,000 Impervious slope"
0,370 Pervious Manning "n"
68,300 Pervious SCS Curve No. "
0,290 Pervious Runoff coefficient"
0,100 Pervious Ia/S coefficient"
11,789 Pervious Initial abstraction"
0,013 Impervious Manning "n"
98,000 Impervious SCS Curve No. "
0,935 Impervious Runoff coefficient"
0,100 Impervious Ia/S coefficient"
0,518 Impervious Initial abstraction"
357,869 0,000 0,000
Catchment 100 Pervious Impervious Total Area "
Surface Area 40462,883 1080,118 41543,000 hectare"
Time of concentration 1081,972 0,695 996,436 minutes"
Time to Centroid 2067,263 747,252 1962,838 minutes"
Rainfall depth 82,400 82,400 82,400 mm"
Rainfall volume 3334,1416 89,0017 3423,1433 ha-m"
Rainfall losses 58,469 5,393 57,089 mm"
Runoff depth 23,931 77,007 25,311 mm"
Runoff volume 968,3257 83,1762 1051,5067 ha-m"
Runoff coefficient 0,290 0,935 0,307
Maximum flow HYDROGRAPH Add Runoff " 84,440 299,910 357,869 c.m/sec"
4 Add Runoff " 357,869 357,869 0,000"
38 START/RE-START TOTALS 100"
Page 1

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212326 - 25 - OD - Jan18.Out
-----
3 Runoff Totals on EXIT"
Total Catchment area 41543,000 hectare"
Total Impervious area 1080,118 hectare"
Total % Impervious 2,600"
EXIT"

```

```

212326 - 50 - OD - Jan18.Out
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MIDUSS created      Sunday, February 07, 2010
Units used:         Metric
Job folder:         C:\MIDUSS\RIVERSDALE\MIDUSS
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Licensee name:      Hewlett-Packard Company
Company:            DeleteMe
Date & time last used: 1/29/2018 at 10:16:17 AM

TIME PARAMETERS
31 5.000 Time Step
    1440.000 Max. Storm Length
    4800.000 Max. Hydrograph
32 STORM MASS CURVE
    3 Mass Curve
    90.800 Rainfall depth
    1440.000 Duration
    48 C:\Program Files (x86)\MIDUSS\SCS_Type2_24hr.mrd SCS 24 hour Type

II storm
    Maximum intensity      111.140 mm/hr
    Total depth            90.800 mm
    6 050hyd Hydrograph extension used in this file"
    CATCHMENT 100
    2 Rectangular
    3 Specify values
    1 SCS method
    100 TOTAL
    2.600 % Impervious
    41543.000 Total Area
    25886.000 Flow Length
    3.000 Overland Slope
    40462.883 Pervious Area
    25886.000 Pervious Length
    3.000 Pervious Slope
    1080.118 Impervious Area
    5.000 Impervious Length
    2.000 Impervious Slope
    0.370 Pervious Manning "n"
    68.300 Pervious SCS Curve No.
    0.322 Pervious Runoff Coefficient
    0.100 Pervious Ia/S Coefficient
    11.789 Pervious Initial Abstraction
    0.013 Impervious Manning "n"
    98.000 Impervious SCS Curve No.
    0.940 Impervious Runoff Coefficient
    0.100 Impervious Ia/S Coefficient
    0.518 Impervious Initial Abstraction
    406.996 0.000
    Catchment 100 Pervious
    Surface Area 40462.883 Impervious Total Area
    Time of concentration 1008.451 1080.118 Hectare
    Time to Centroid 2030.071 935.625 minutes
    Rainfall depth 90.800 1937.240 minutes
    Rainfall volume 3674.0300 90.800 mm
    Rainfall losses 61.540 3772.1047 ha-m
    Runoff depth 29.260 5.421 mm
    Runoff volume 1183.9390 30.719 mm
    Runoff Coefficient 0.322 1276.1578 ha-m
    Maximum flow 109.176 0.940 c.m/sec
    HYDROGRAPH Add Runoff " 330.969 406.996 c.m/sec"
    4 Add Runoff " 0.000 0.000"
    START/RE-START TOTALS 100"

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212326 - 50 - OD - Jan18.Out
-----
3 Runoff Totals on EXIT"
Total Catchment area 41543.000 hectare
Total Impervious area 1080.118 hectare
Total % Impervious 2.600"
EXIT"

```

```

212326 - 100-year - OD - Jan18.out
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Licensee name:          DeleteMe
Company                 Hewlett-Packard Company
Date & Time last used:  1/23/2018 at 3:10:44 PM

TIME PARAMETERS
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1440.000 Max. Storm length
4800.000 Max. Hydrograph
32 STORM Mass Curve
99.200 Rainfall depth
1440.000 Duration
48 C:\Program Files (x86)\MIDUSS\SCS_Type2_24hr.mrd SCS 24 hour Type

II storm
Maximum intensity 121.422 mm/hr
Total depth 99.200 mm
6 100hyd Hydrograph extension used in this file"
CATCHMENT 100
2 Rectangular
3 Specify values"
1 SCS method
100 TOTAL
2.600 % Impervious
41543.000 Total Area
25886.000 Flow length
3.000 Overland Slope
40462.883 Pervious Area
25886.000 Pervious length
3.000 Pervious slope
1080.118 Impervious Area
5.000 Impervious length
2.000 Impervious slope
0.370 Pervious Manning "n"
68.300 Pervious SCS Curve No.
0.351 Pervious Runoff coefficient
0.000 Pervious Ia/S coefficient
11.789 Pervious Initial abstraction"
0.013 Impervious Manning "n"
98.000 Impervious SCS Curve No.
0.945 Impervious Runoff coefficient"
0.100 Impervious Ia/S coefficient"
0.518 Impervious Initial abstraction"
458.519 0.000
Catchment 100 Pervious 0.000 c.m/sec"
Surface Area 40462.883 1080.118 41543.000 hectare"
Time of concentration 947.776 0.645 884.333 minutes"
Time to Centroid 1993.250 743.855 1909.560 minutes"
Rainfall depth 99.200 99.200 99.200 mm"
Rainfall volume 4013.9180 107.1477 4121.0659 ha-m"
Rainfall losses 64.340 5.443 62.808 mm"
Runoff depth 34.860 93.757 36.392 mm"
Runoff volume 1410.5515 101.2684 1511.8195 ha-m"
Runoff coefficient 0.351 0.945 0.367 c.m/sec"
Maximum flow 136.957 361.996 458.519 c.m/sec"
HYDROGRAPH Add
4 Add Runoff
458.519 458.519 0.000 0.000"
START/RE-START TOTALS 100"
Page 1

```

```

212326 - 100-year - OD - Jan18.out
-----
3 Runoff Totals on EXIT"
Total Catchment area 41543.000 hectare"
Total Impervious area 1080.118 hectare"
Total % Impervious 2.600"
EXIT"

```

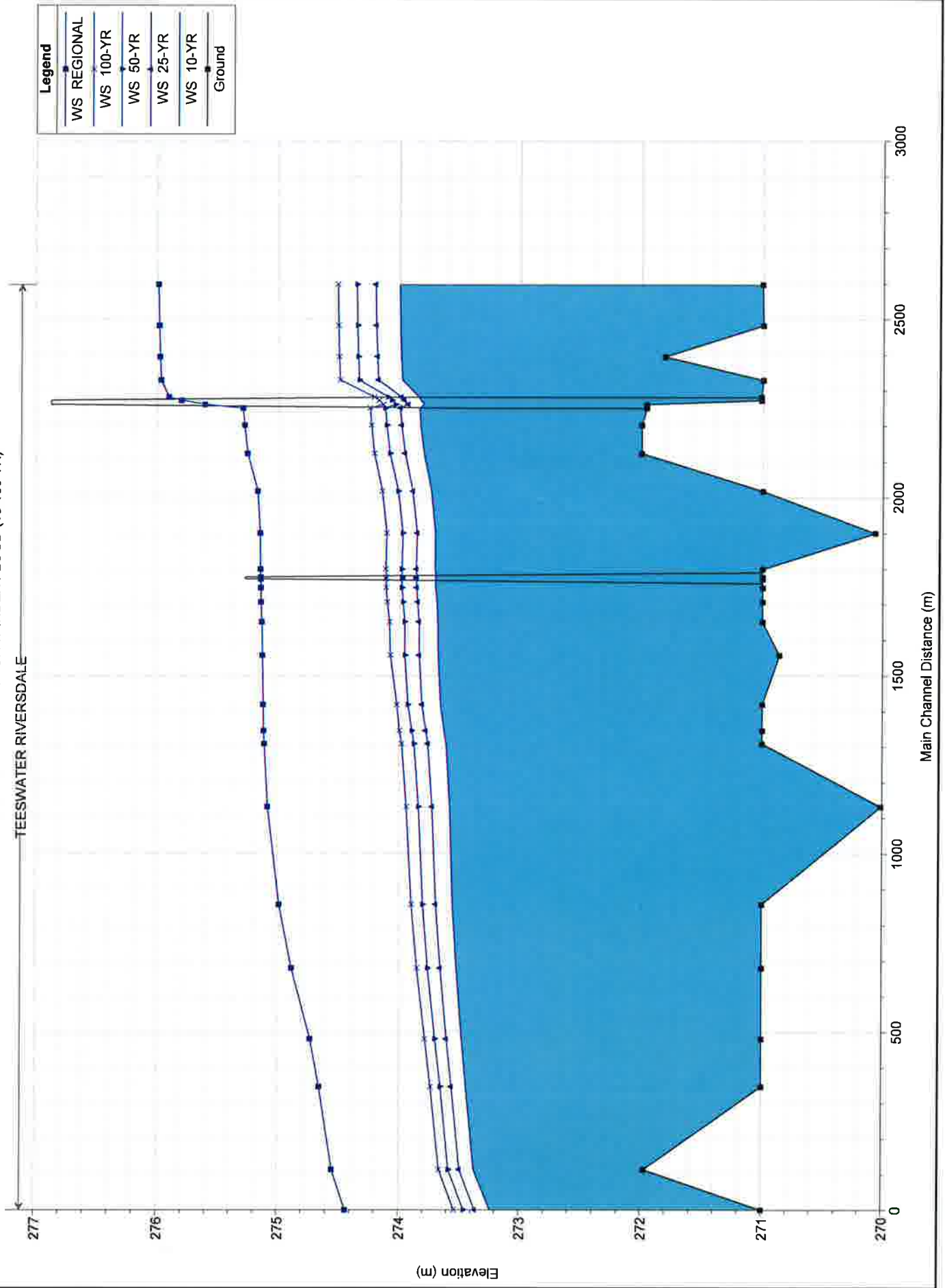
[illegible]

| | | | |
|----------------------------|-------------------|------------------|--------------------|
| | 212326 - Regional | - OD - Jan18.out | |
| Runoff depth | 163.564 | 249.197 | 165.790 mm" |
| Runoff volume | 6618.2710 | 269.1627 | 6887.4336 ha-m" |
| Runoff coefficient | 0.642 | 0.978 | 0.651 " |
| Maximum flow | 668.450 | 142.054 | 734.498 c.m/sec" |
| HYDROGRAPH Add Runoff " | | | |
| 4 Add Runoff " | 734.498 | 734.498 | 0.000 " |
| START/RE-START TOTALS 100" | | | |
| 3 Runoff Totals on EXIT" | | | |
| Total Catchment area | | | 41543.000 hectare" |
| Total Impervious area | | | 1080.118 hectare" |
| Total % impervious | | | 2.600 " |
| TOTAL EXIT" | | | |

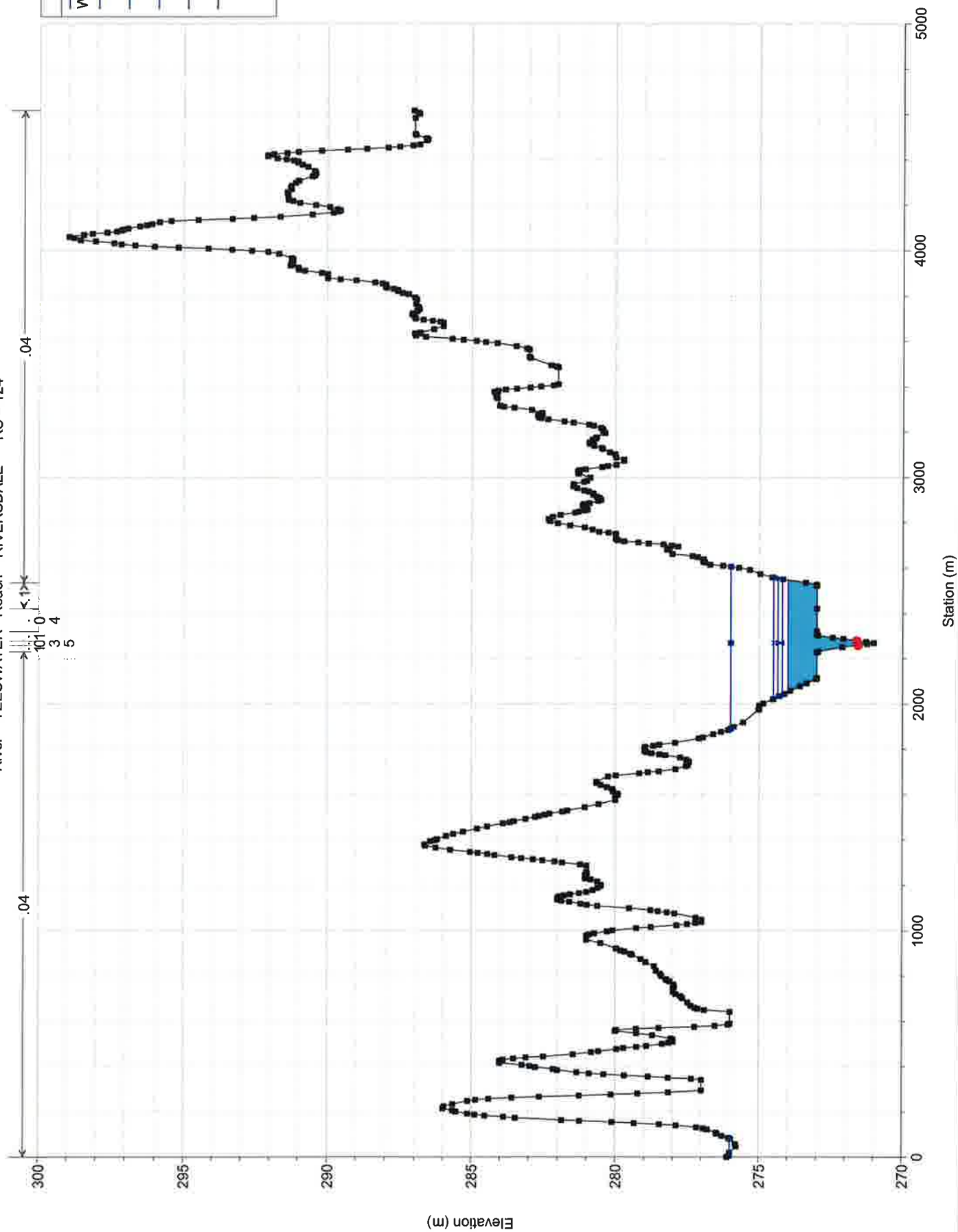
APPENDIX C: FLOODPLAIN MODELING – EXISTING CONDITIONS

HEC-RAS Profile & Cross-Sectional Plots
Bridge No. 0002 Removal & Replacement (Existing Conditions)

RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018
Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)



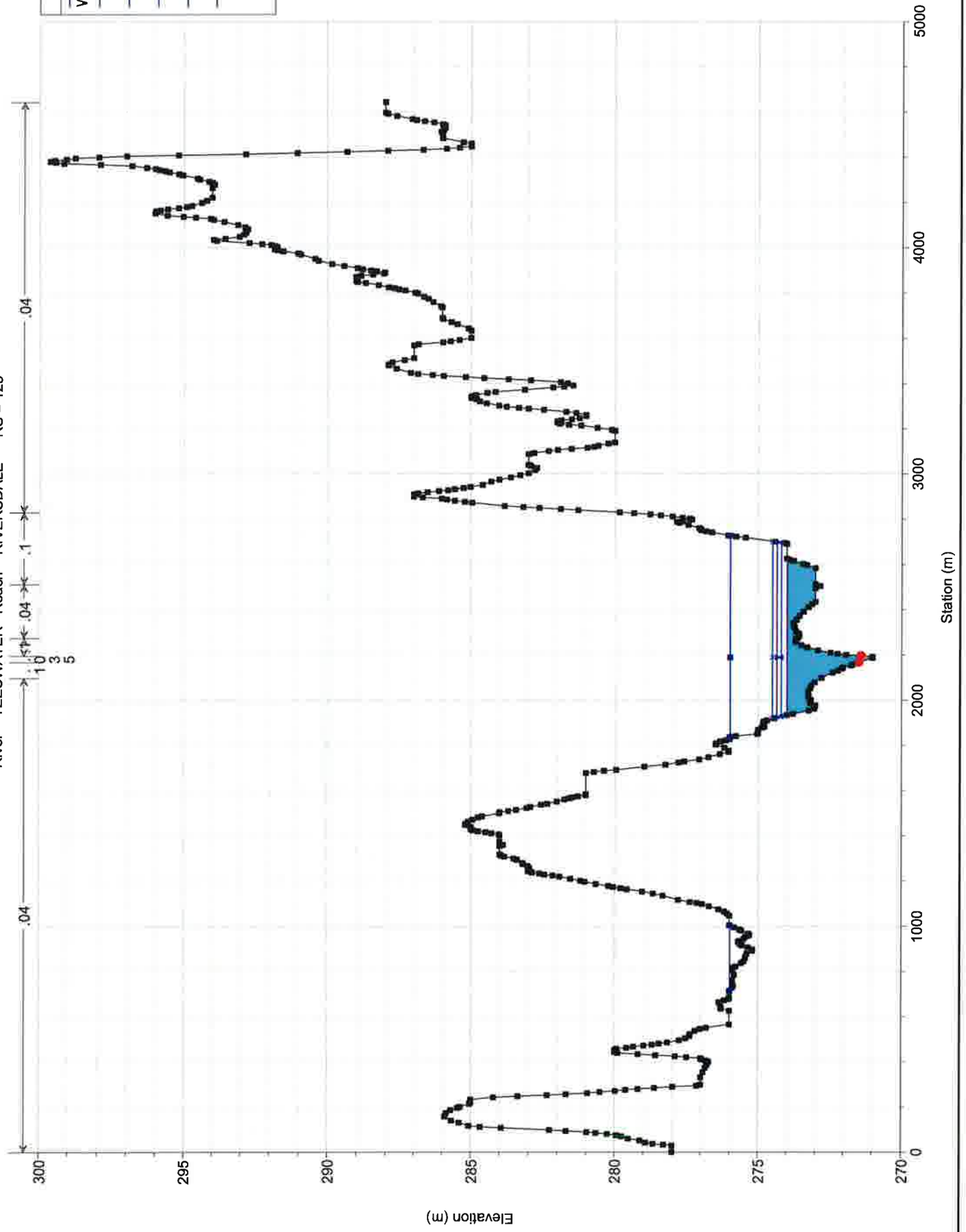
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 Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 124



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

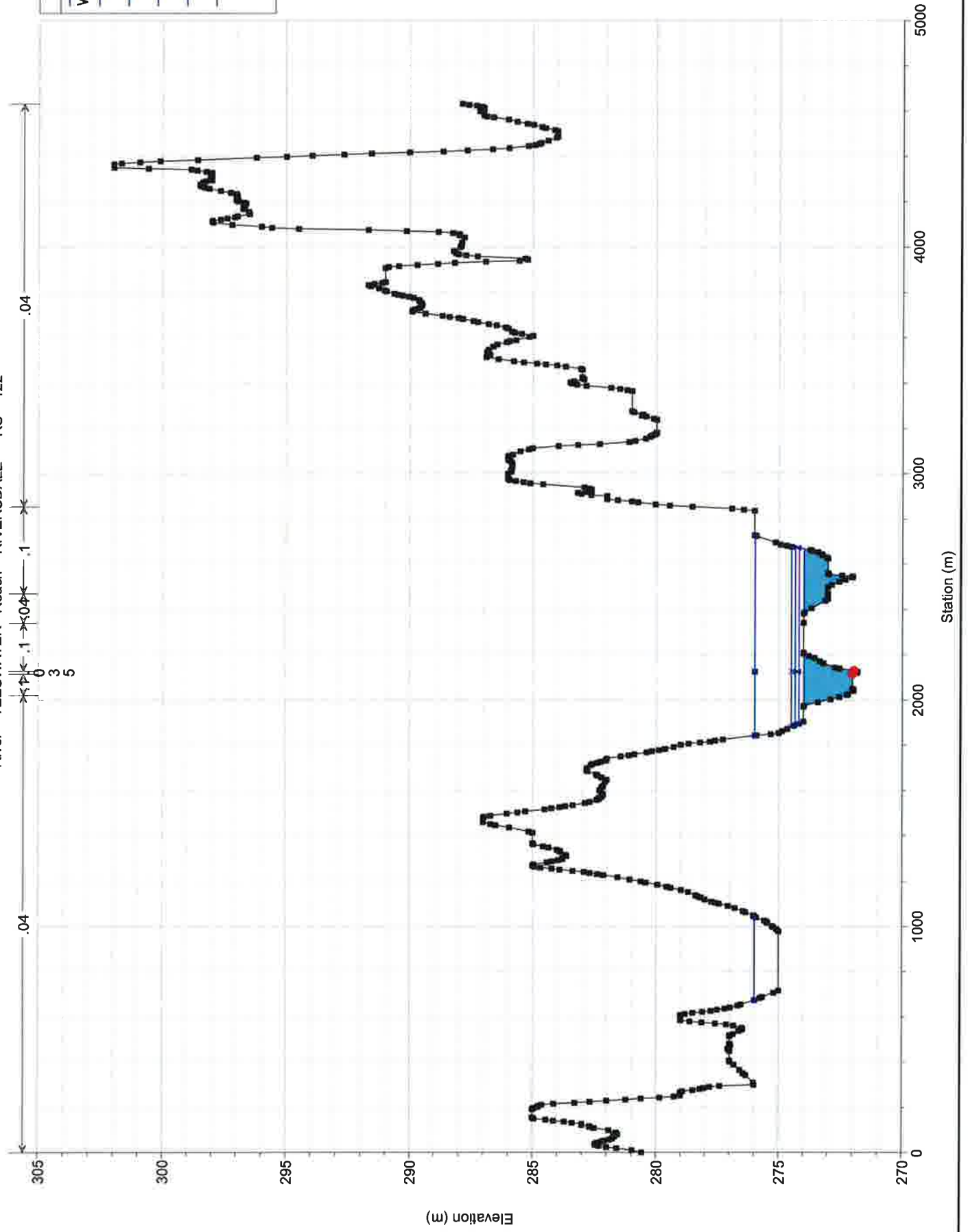
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RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

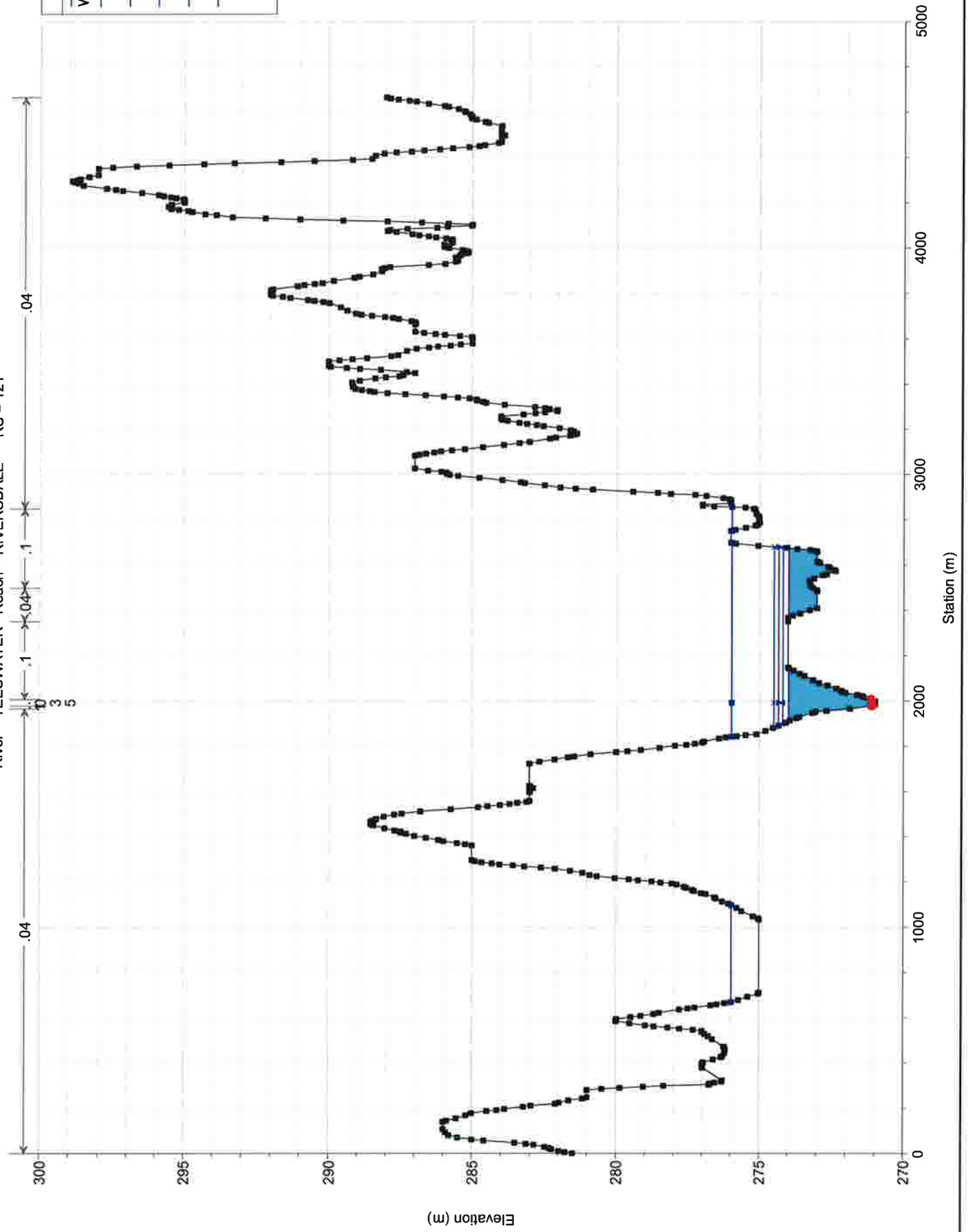
River = TEESWATER Reach = RIVERSDALE RS = 122



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

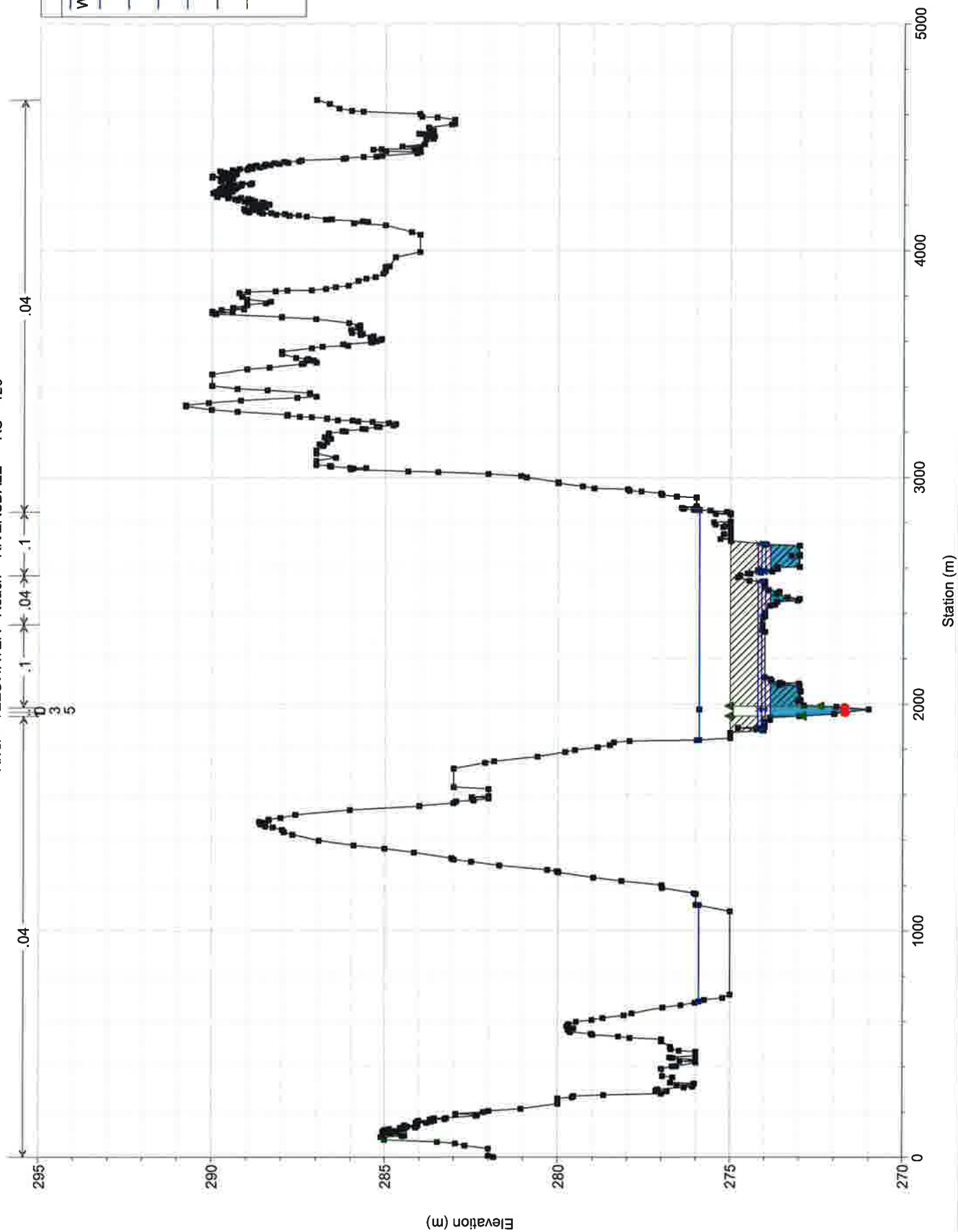
River = TEESWATER Reach = RIVERSDALE RS = 121



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

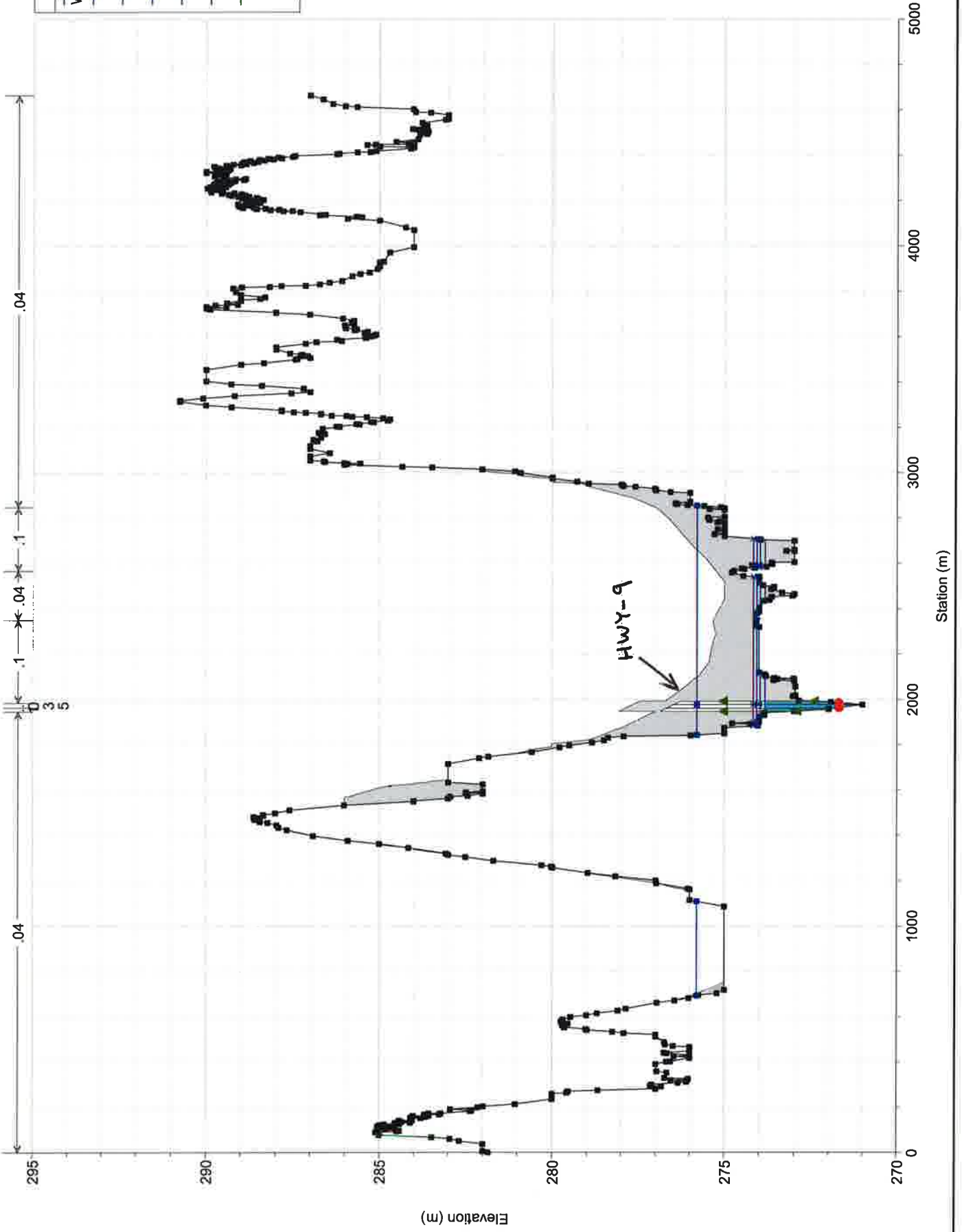
River = TEESWATER Reach = RIVERSDALE RS = 120



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

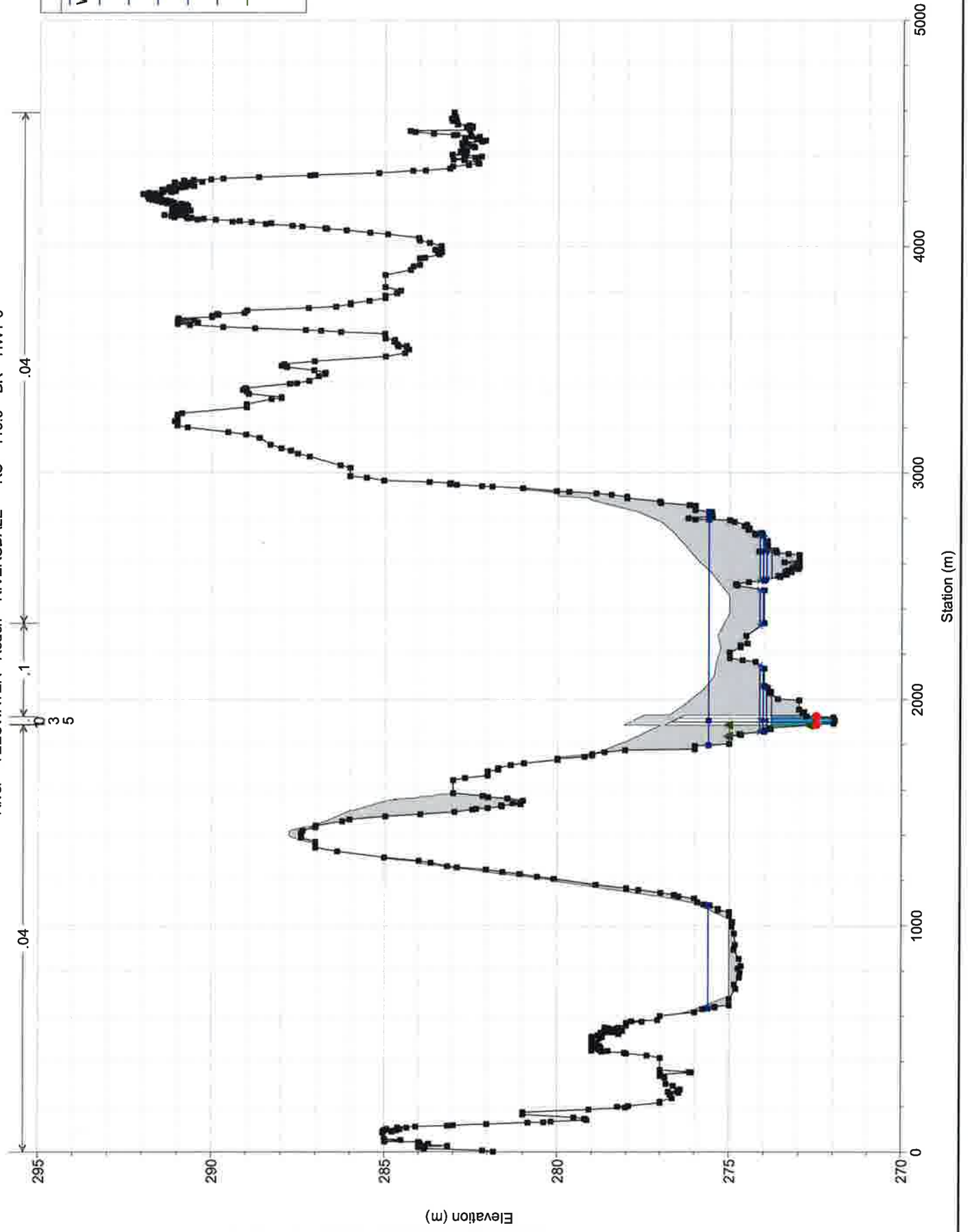
River = TEESWATER Reach = RIVERSDALE RS = 119.5 BR HWY 9



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

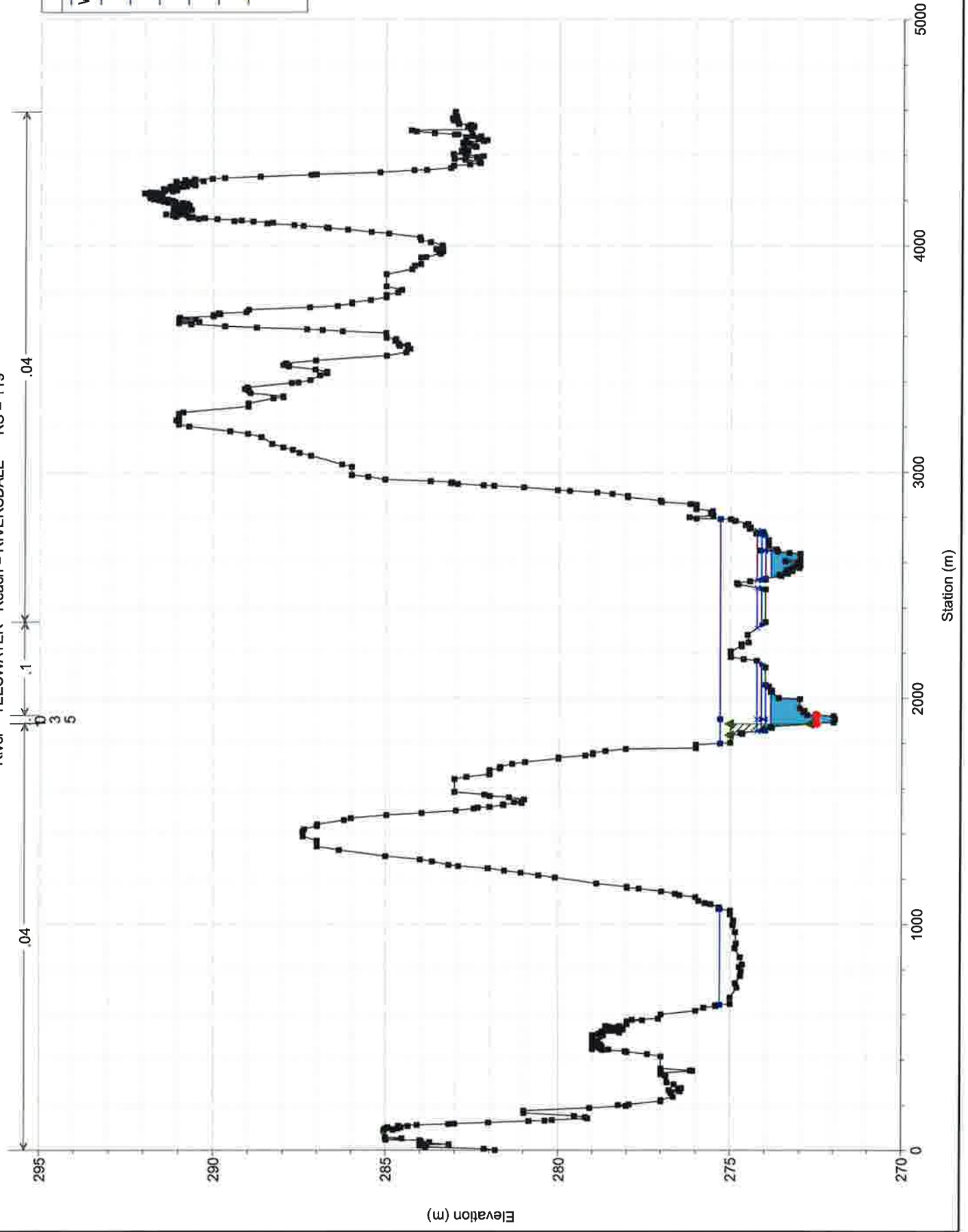
River = TEESWATER Reach = RIVERSDALE RS = 119.5 BR HWY 9



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

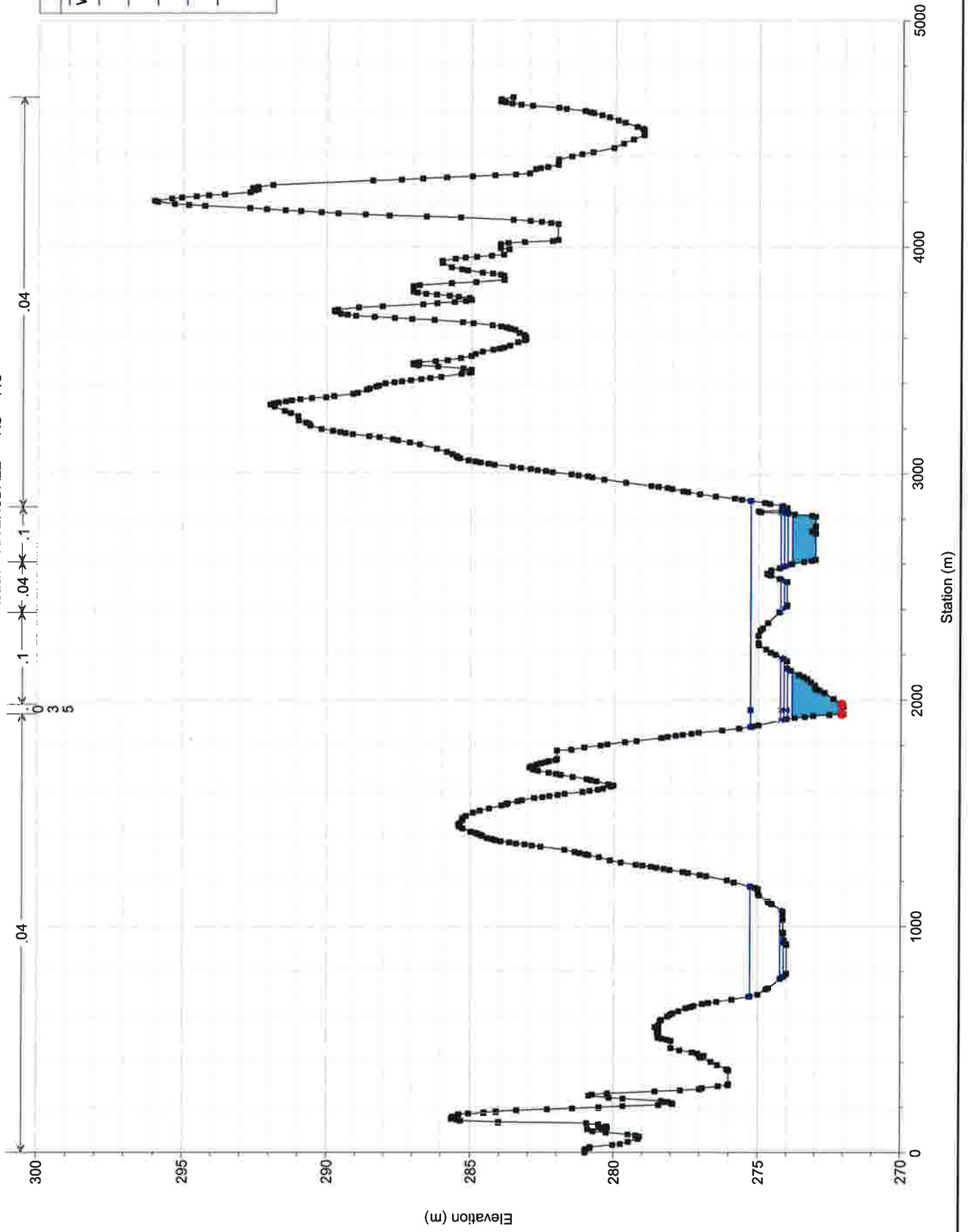
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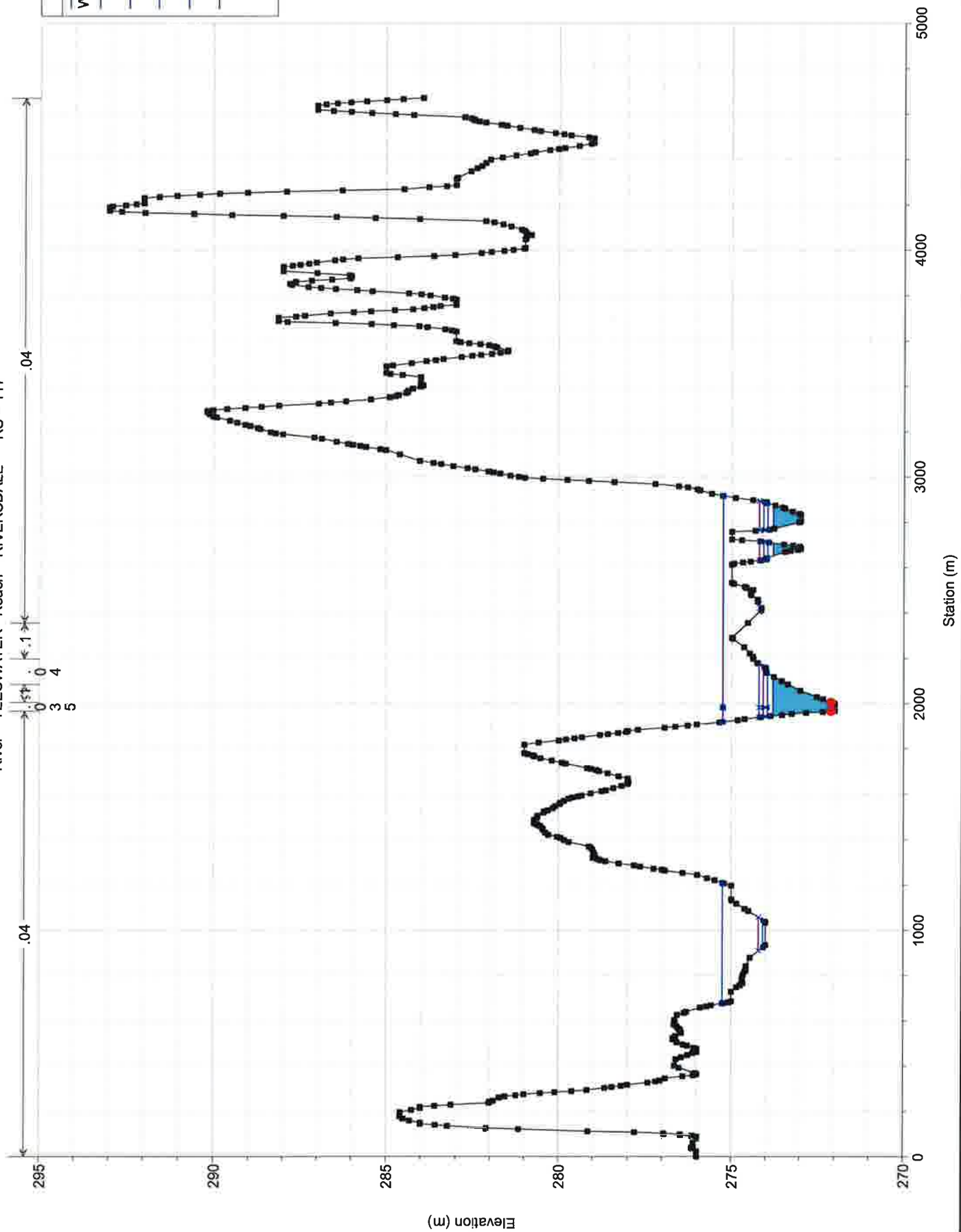
RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 118



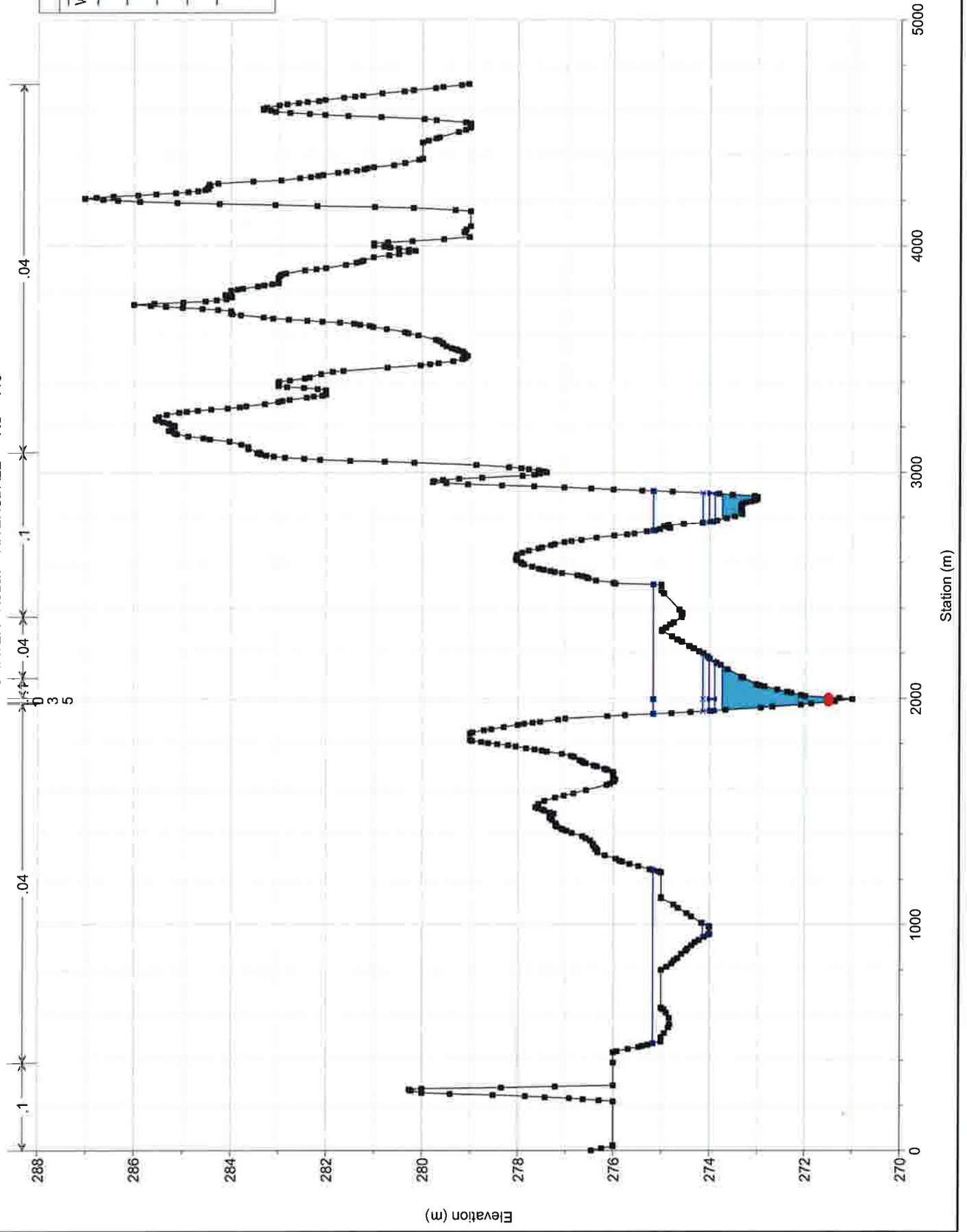
RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018
 Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 117



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

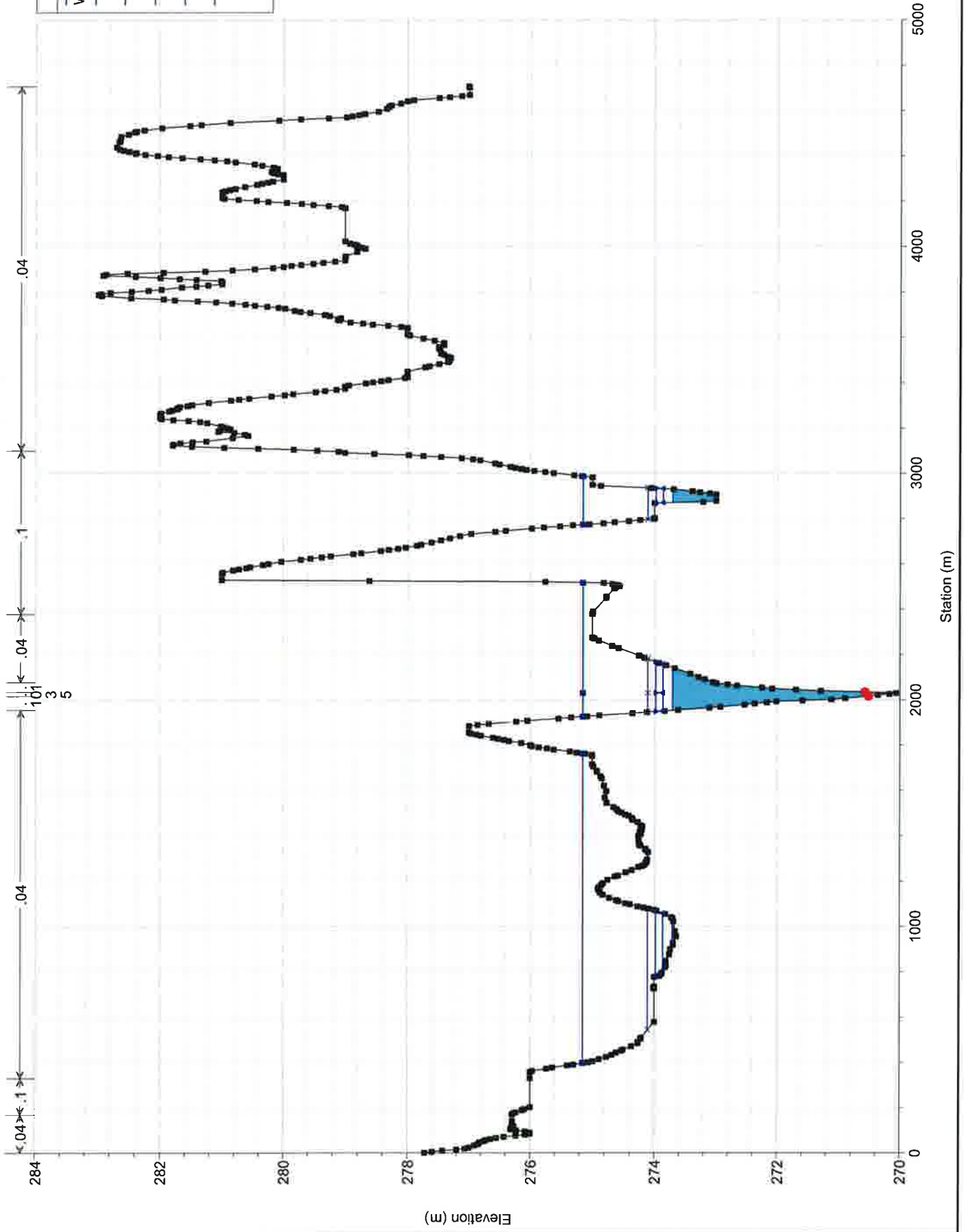
River = TEESWATER Reach = RIVERSDALE RS = 116



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

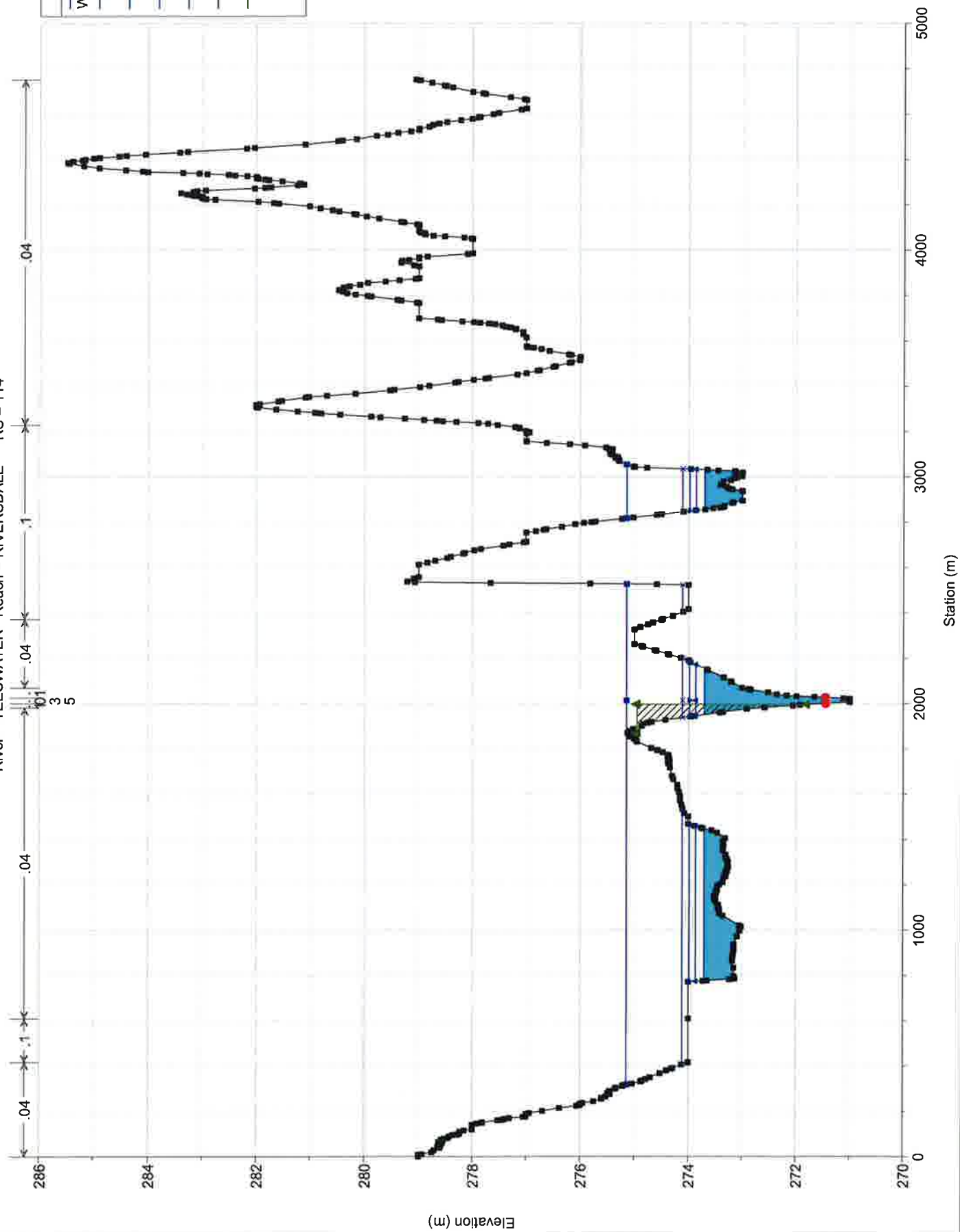
River = TEESWATER Reach = RIVERSDALE RS = 115



| RIVERSDALE | Plan: EX - OFAT INDEX | 1/23/2018 |
|------------|-----------------------|-----------|
|------------|-----------------------|-----------|

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 114

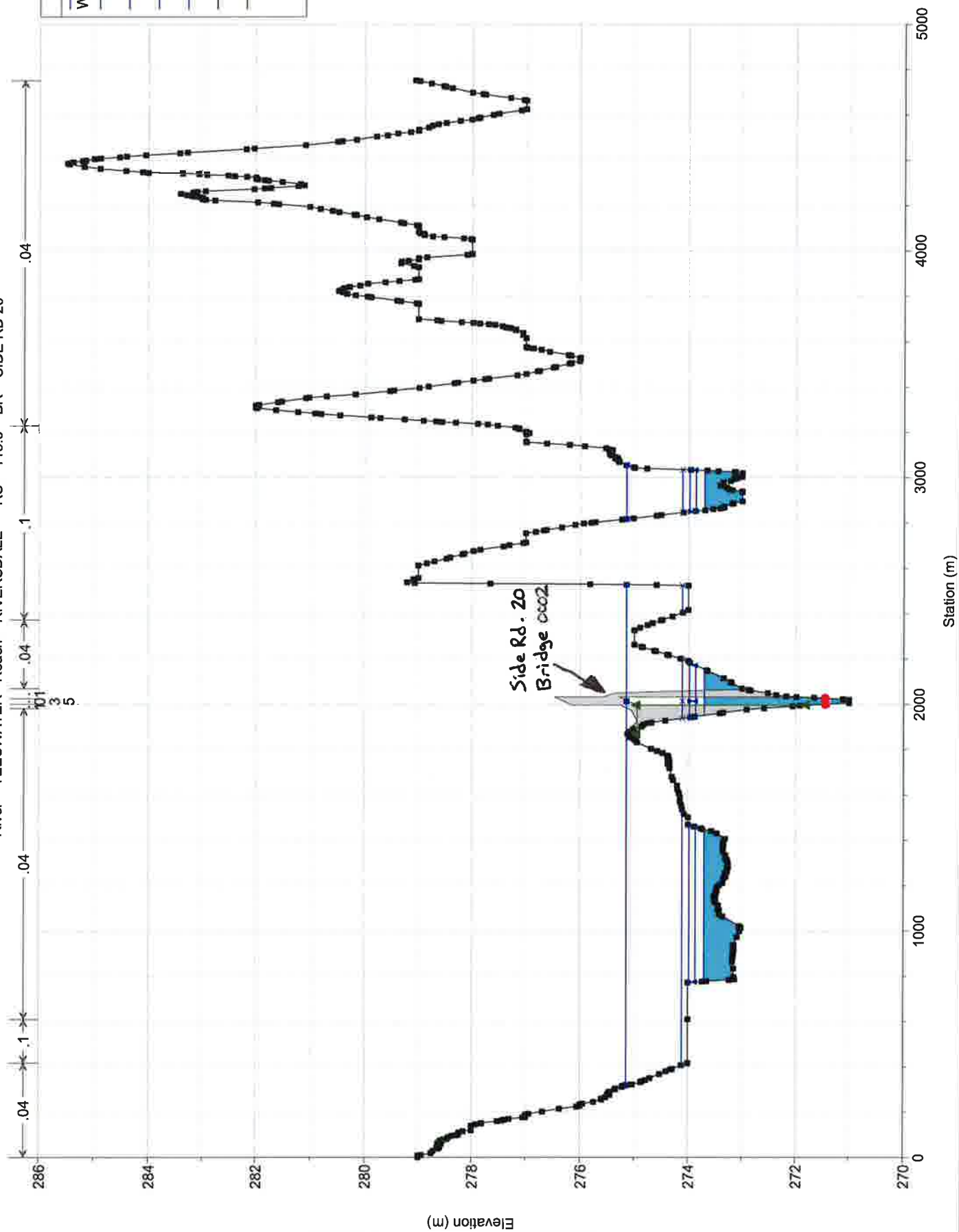


RIVERSDALE

Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

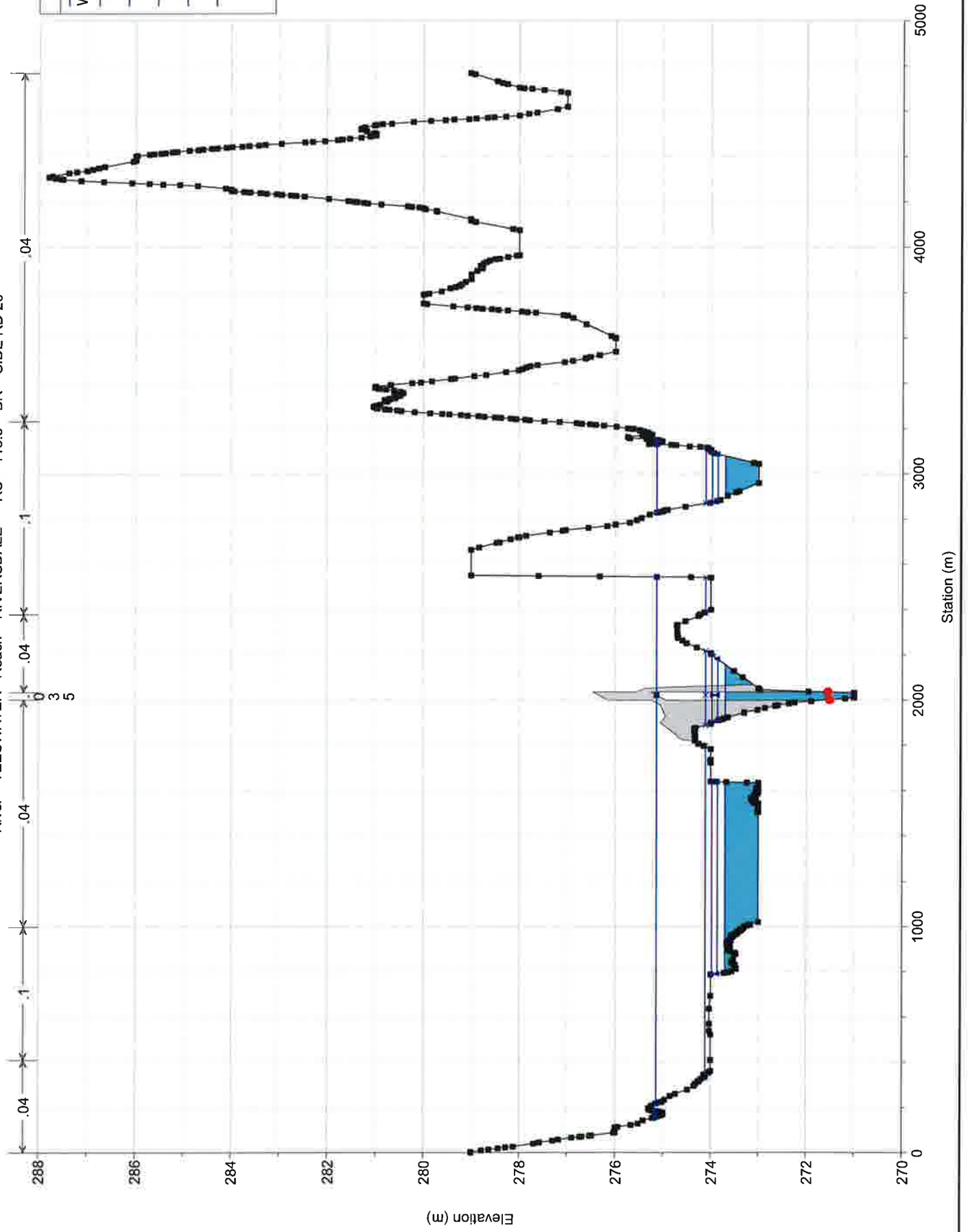
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RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

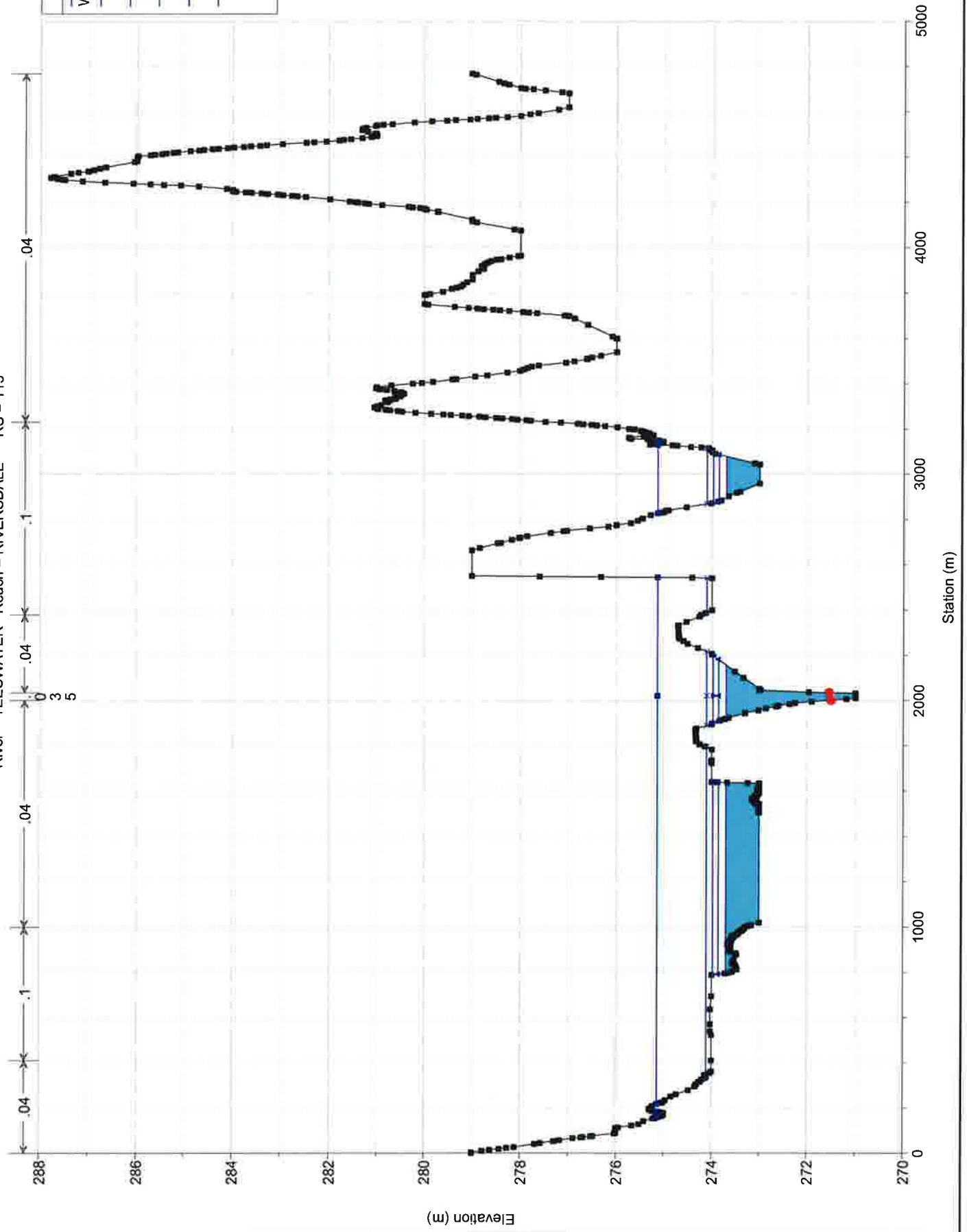
River = TEESWATER Reach = RIVERSDALE RS = 113.5 BR SIDE RD 20



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

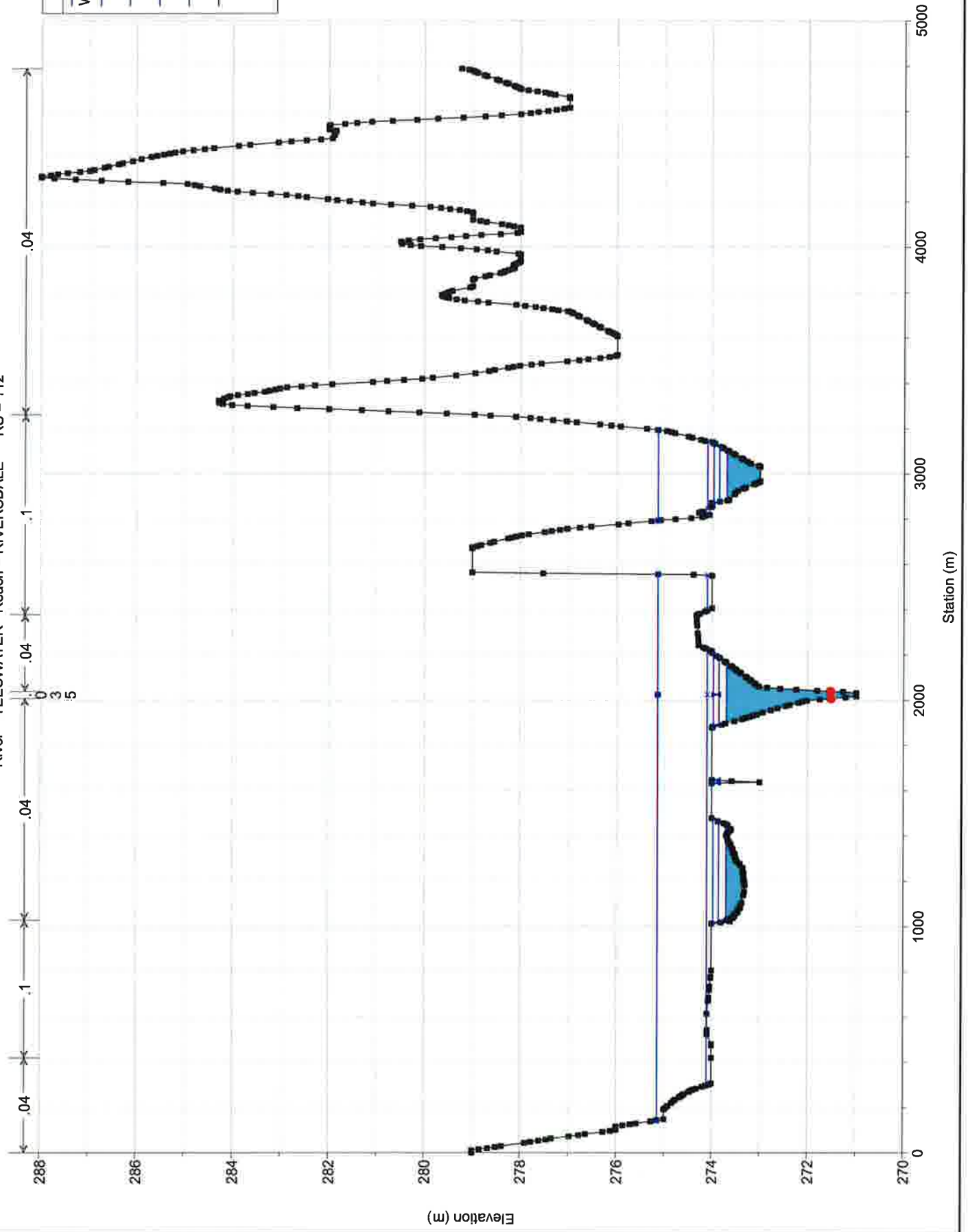
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RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

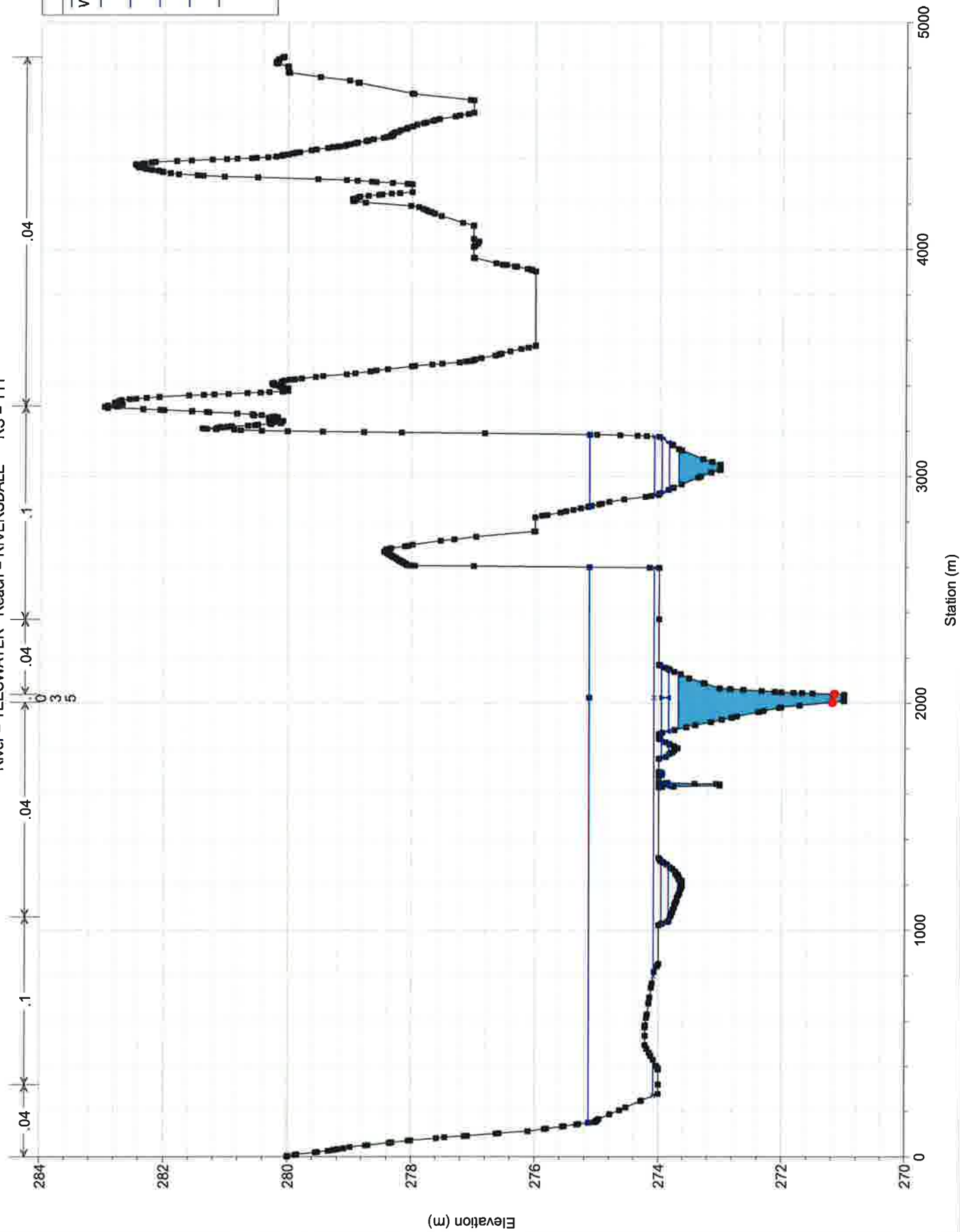
River = TEESWATER Reach = RIVERSDALE RS = 112



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

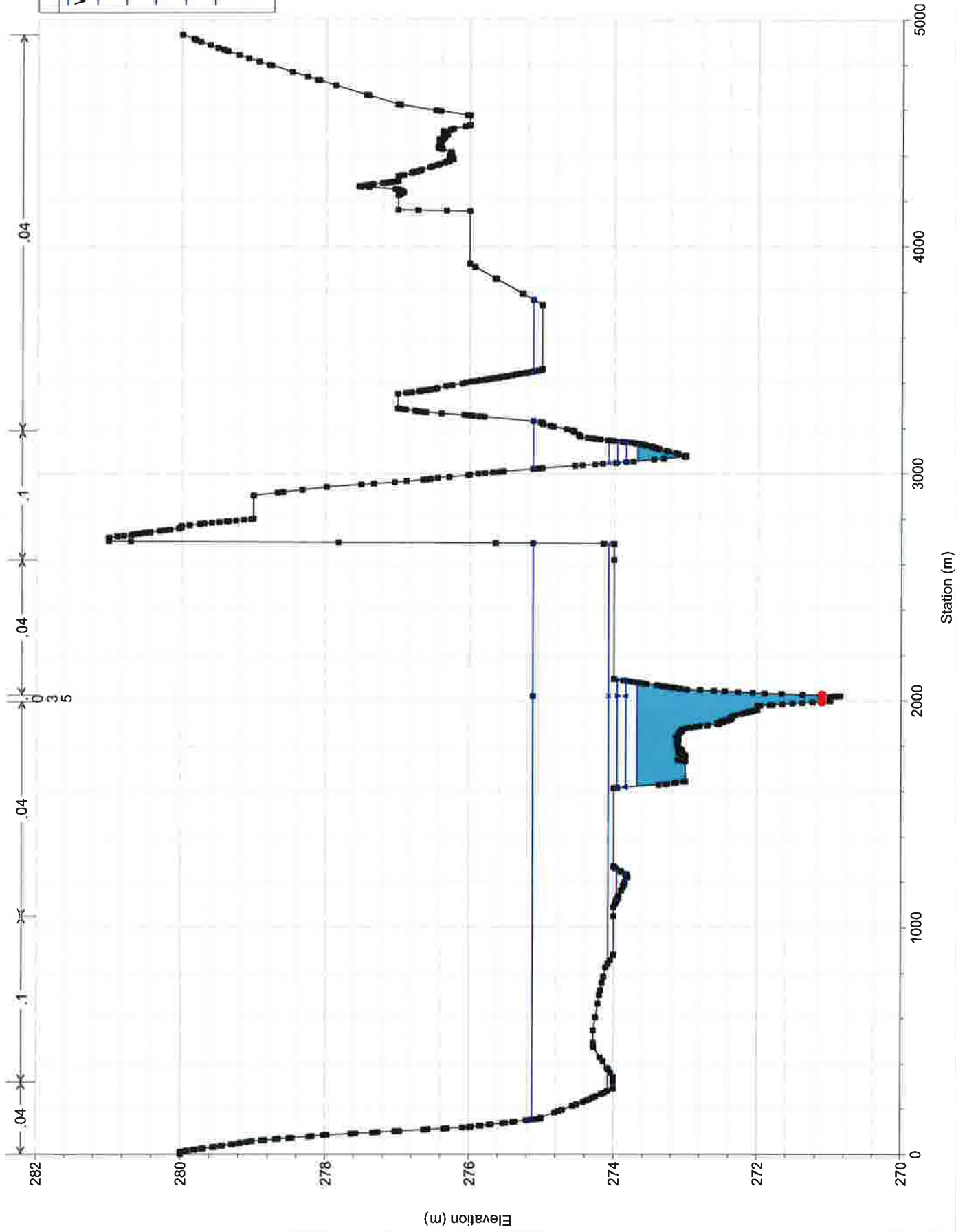
River = TEESWATER Reach = RIVERSDALE RS = 111



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

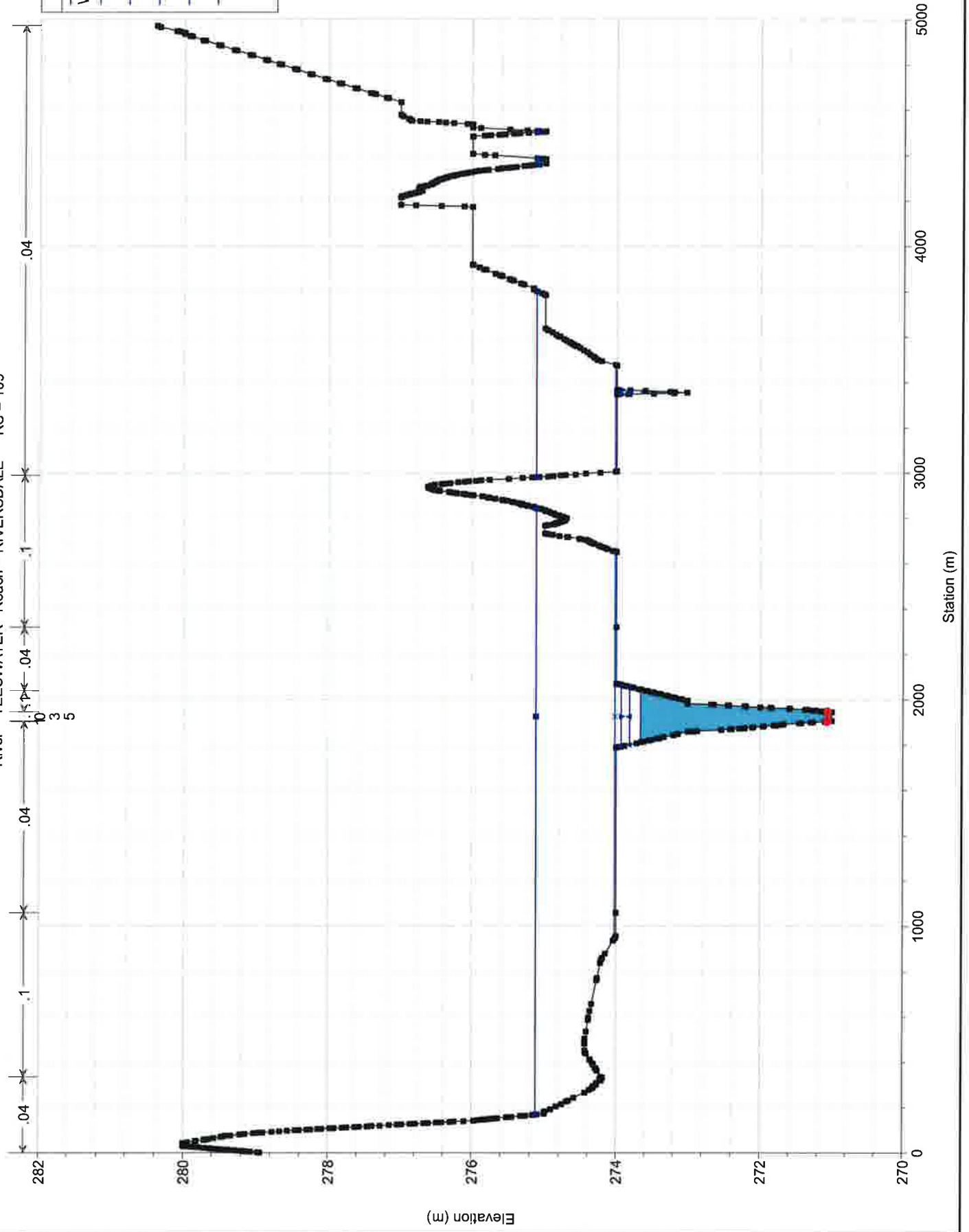
River = TEESWATER Reach = RIVERSDALE RS = 110



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

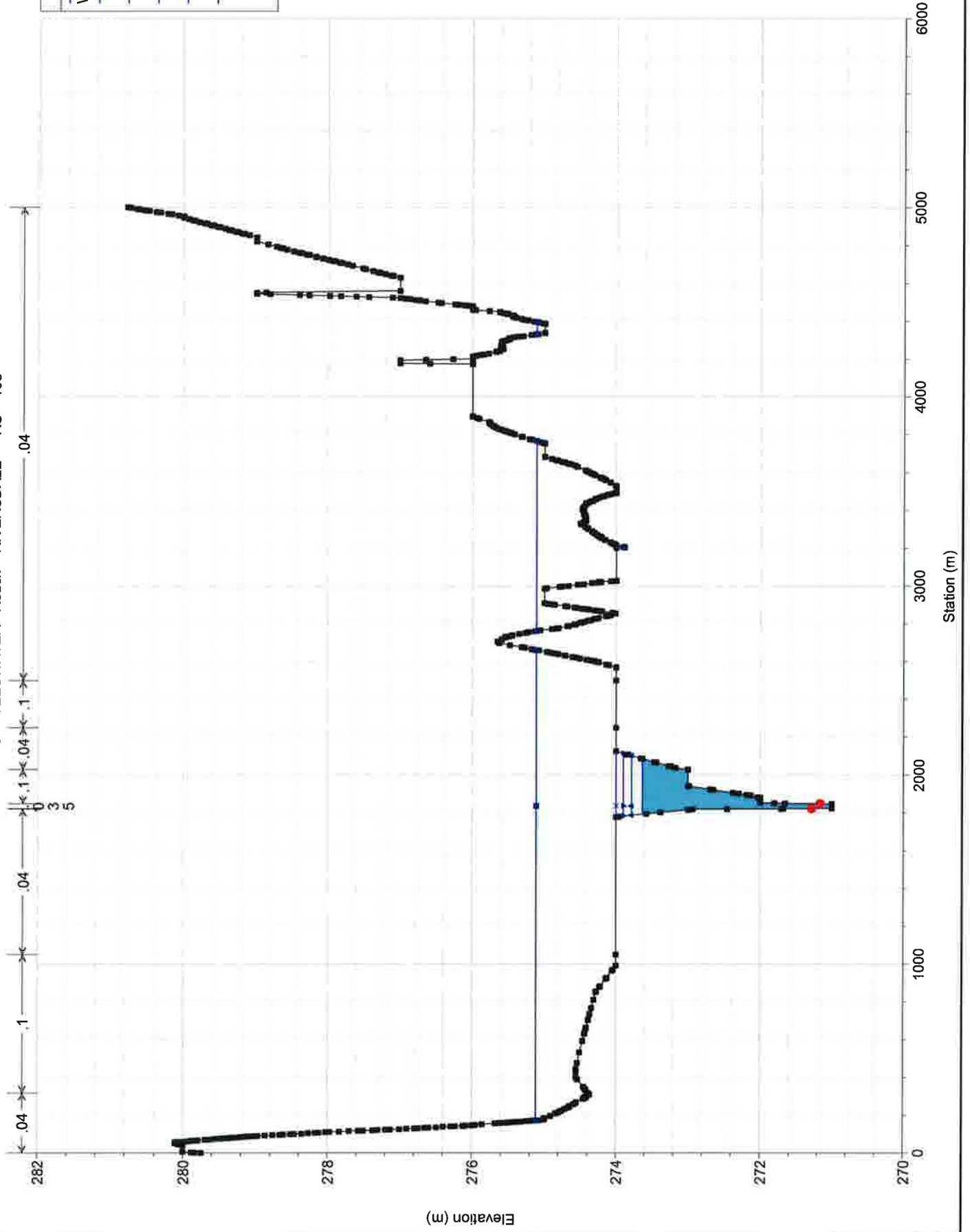
River = TEESWATER Reach = RIVERSDALE RS = 109



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

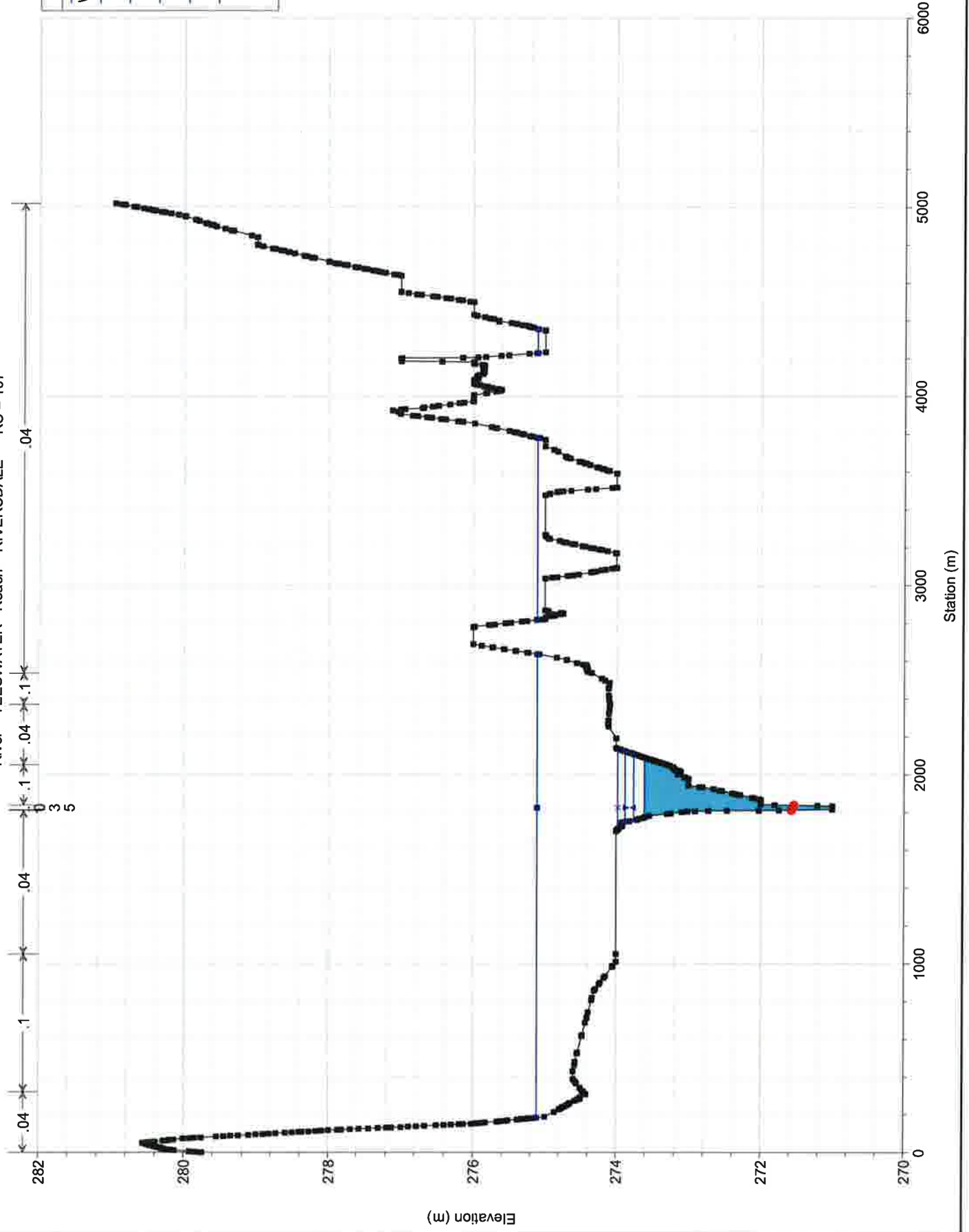
River = TEESWATER Reach = RIVERSDALE RS = 108



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

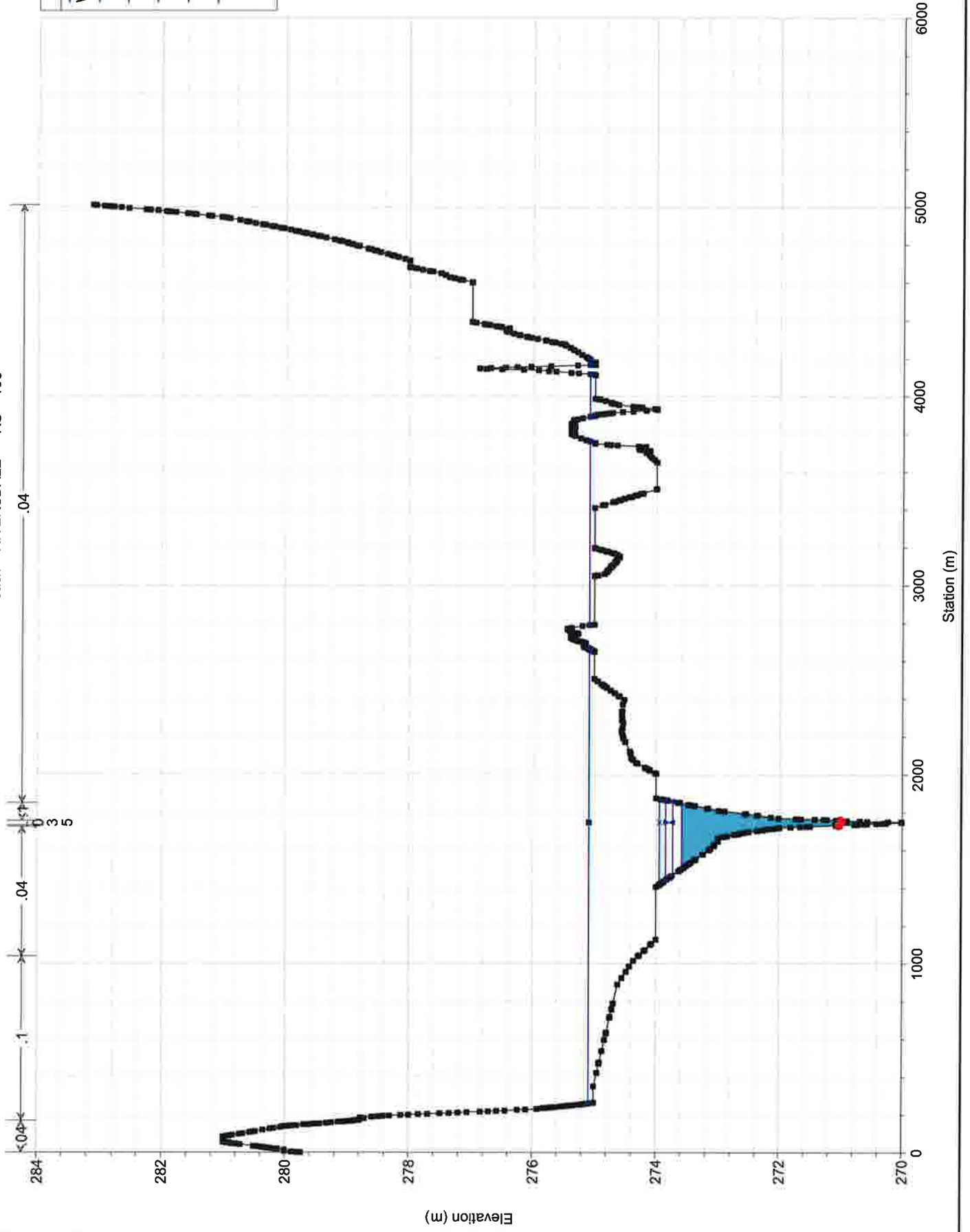
River = TEESWATER Reach = RIVERSDALE RS = 107



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

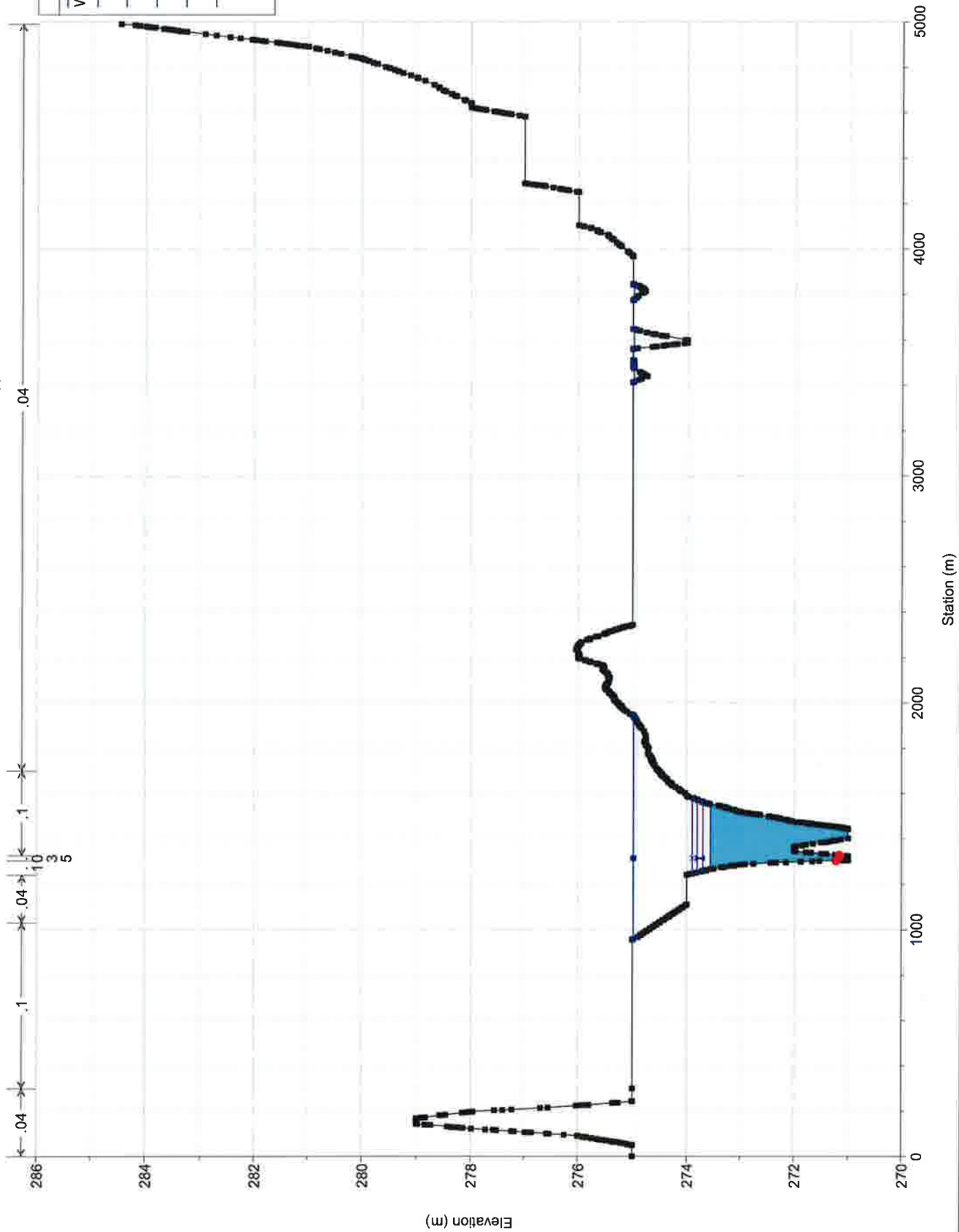
River = TEESWATER Reach = RIVERSDALE RS = 106



RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

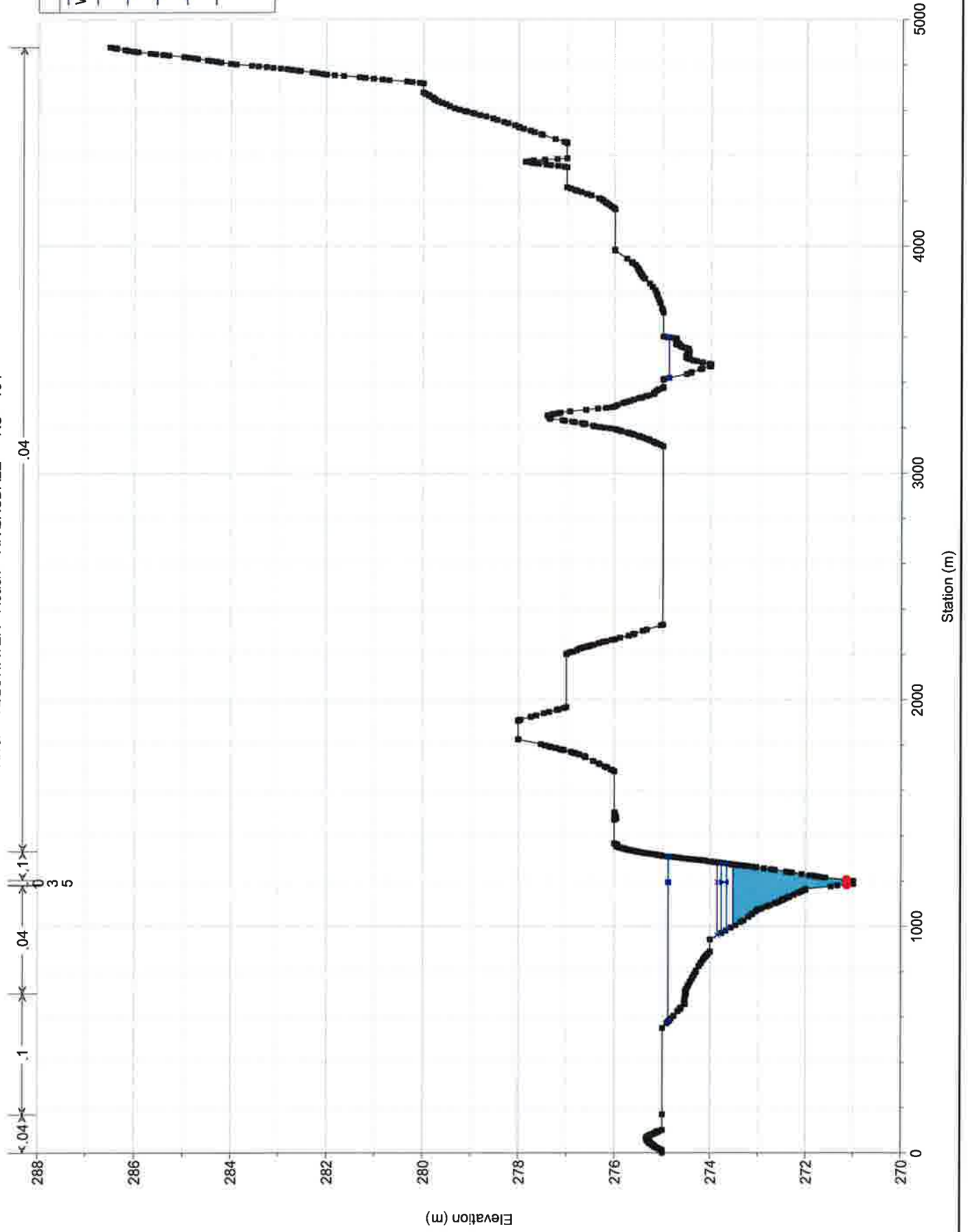
River = TEESWATER Reach = RIVERSDALE RS = 105



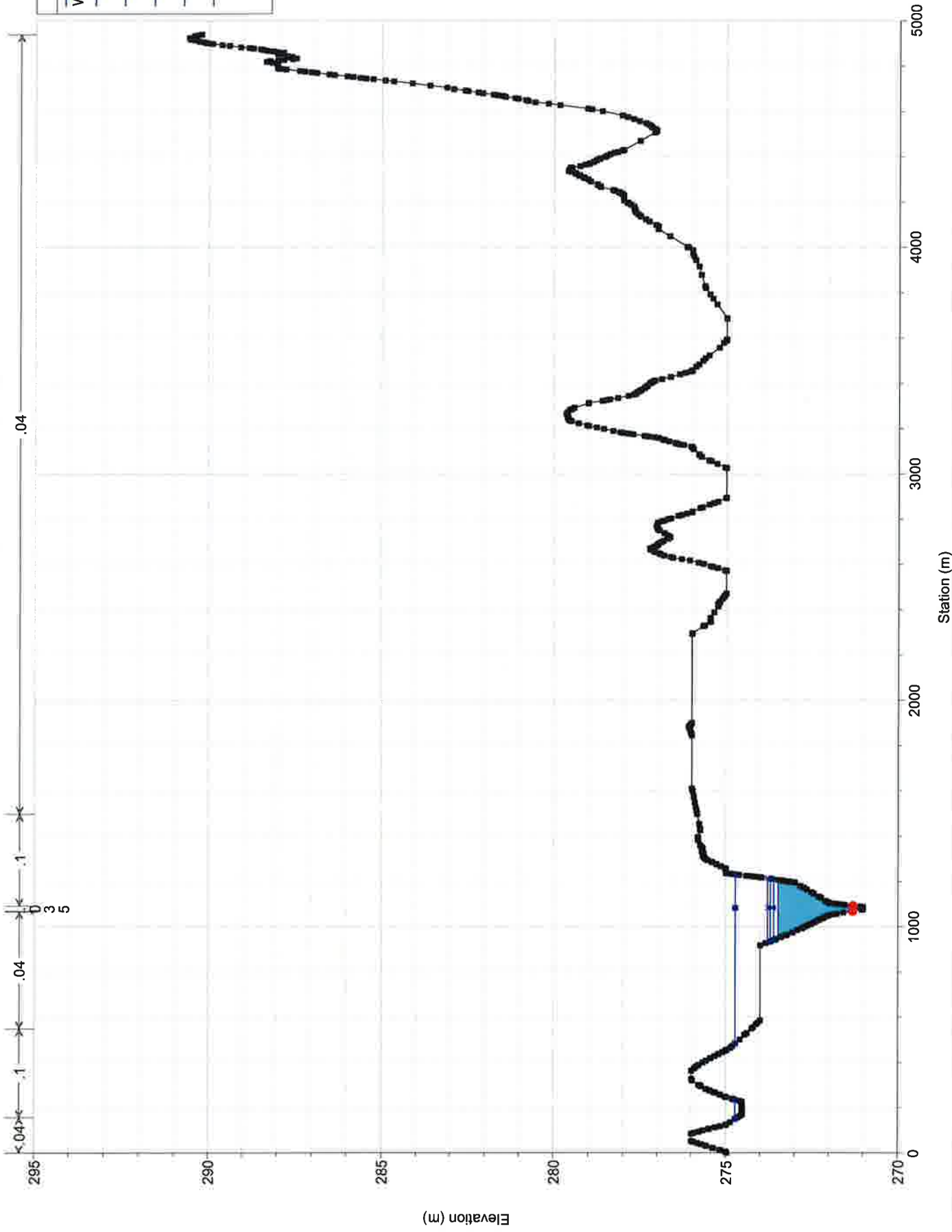
RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 104



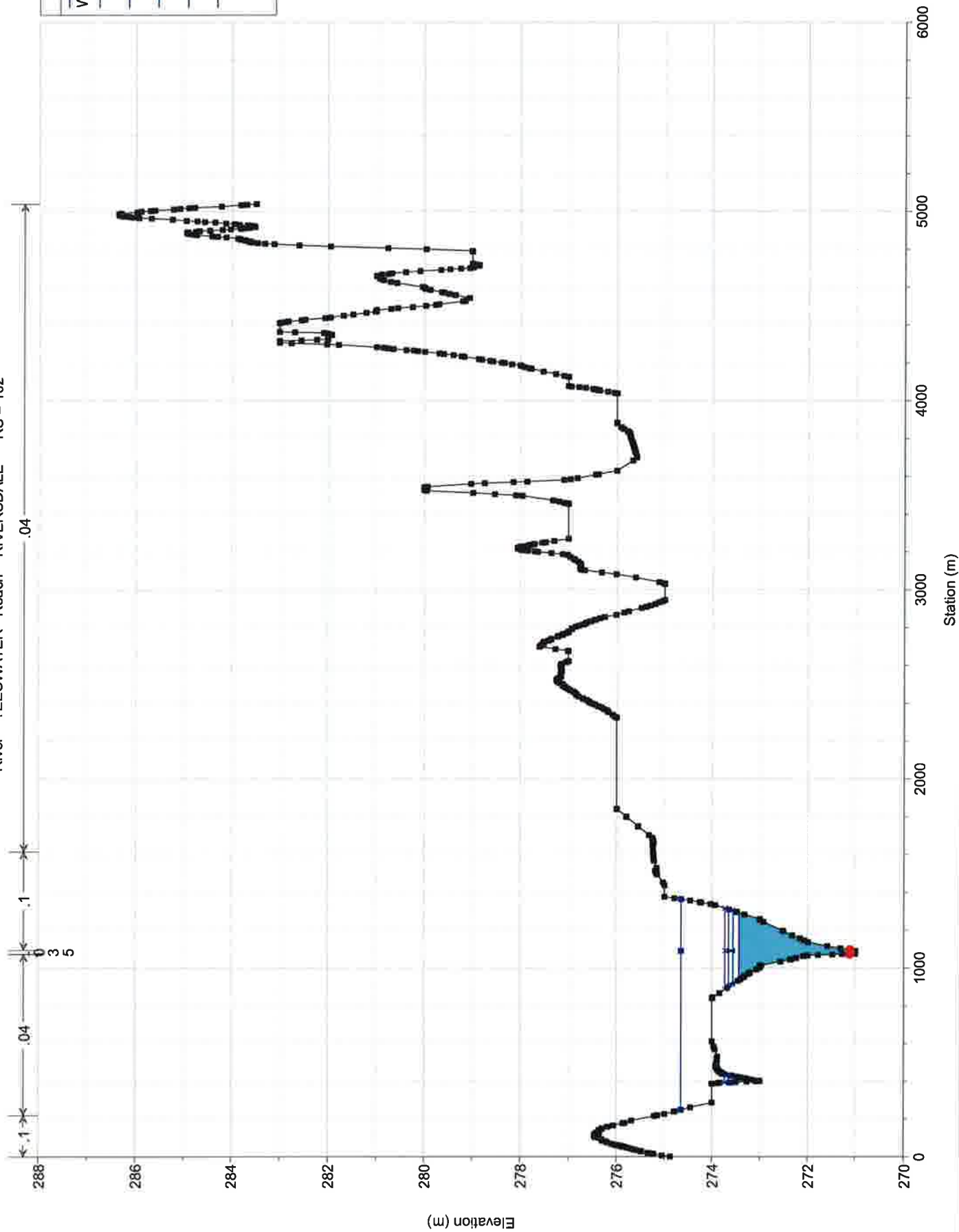
RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018
 Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 103



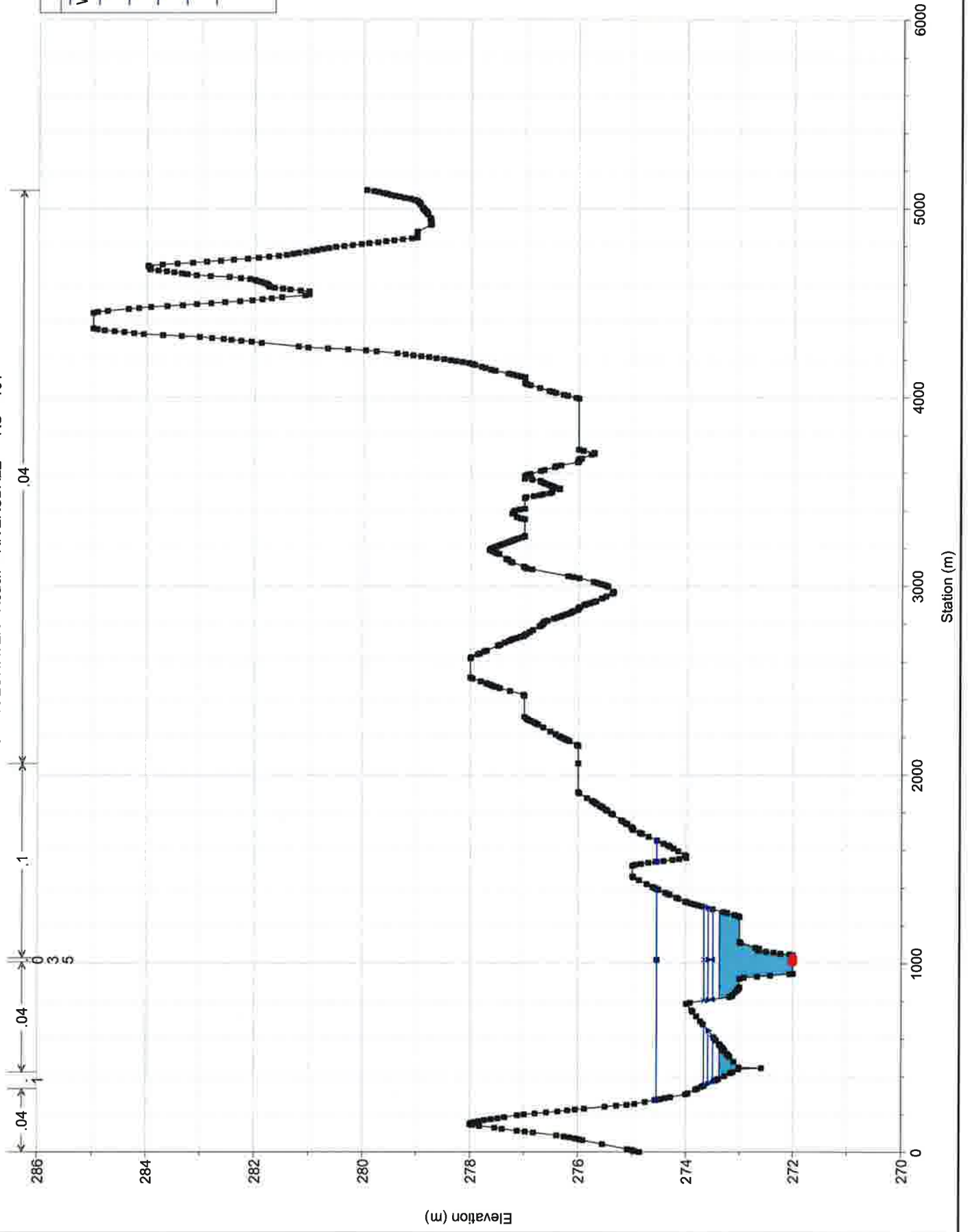
RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018

Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 102

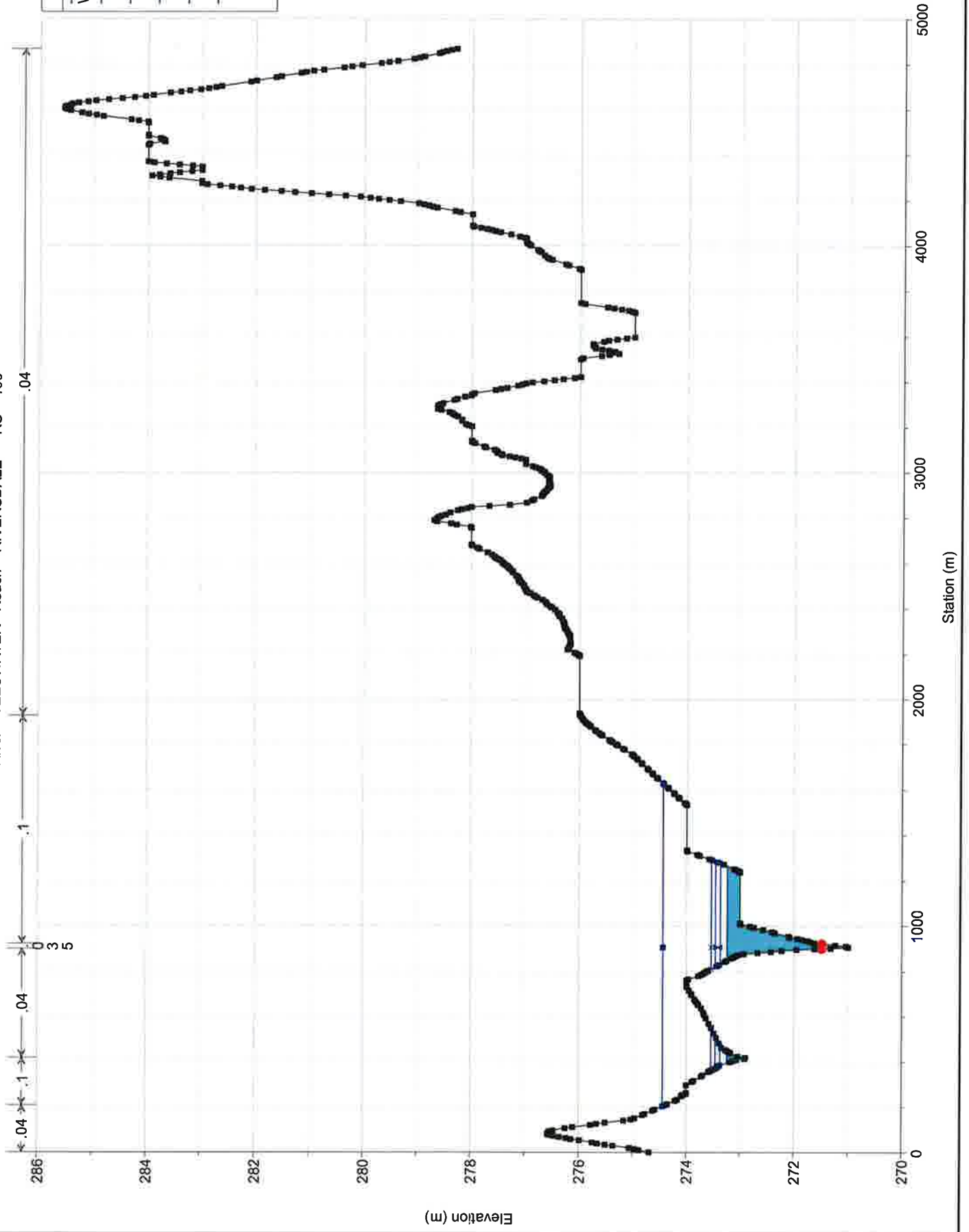


RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018
 Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 101



| Legend | |
|-------------|----------------------------|
| WS REGIONAL | Blue line with dots |
| WS 100-YR | Blue line with 'x' markers |
| WS 50-YR | Blue line with '+' markers |
| WS 25-YR | Blue line with 'o' markers |
| WS 10-YR | Blue line with 'x' markers |
| Ground | Black line with dots |
| Bank Sta | Red dot |

RIVERSDALE Plan: EX - OFAT INDEX 1/23/2018
Geom: EXISTING Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 100



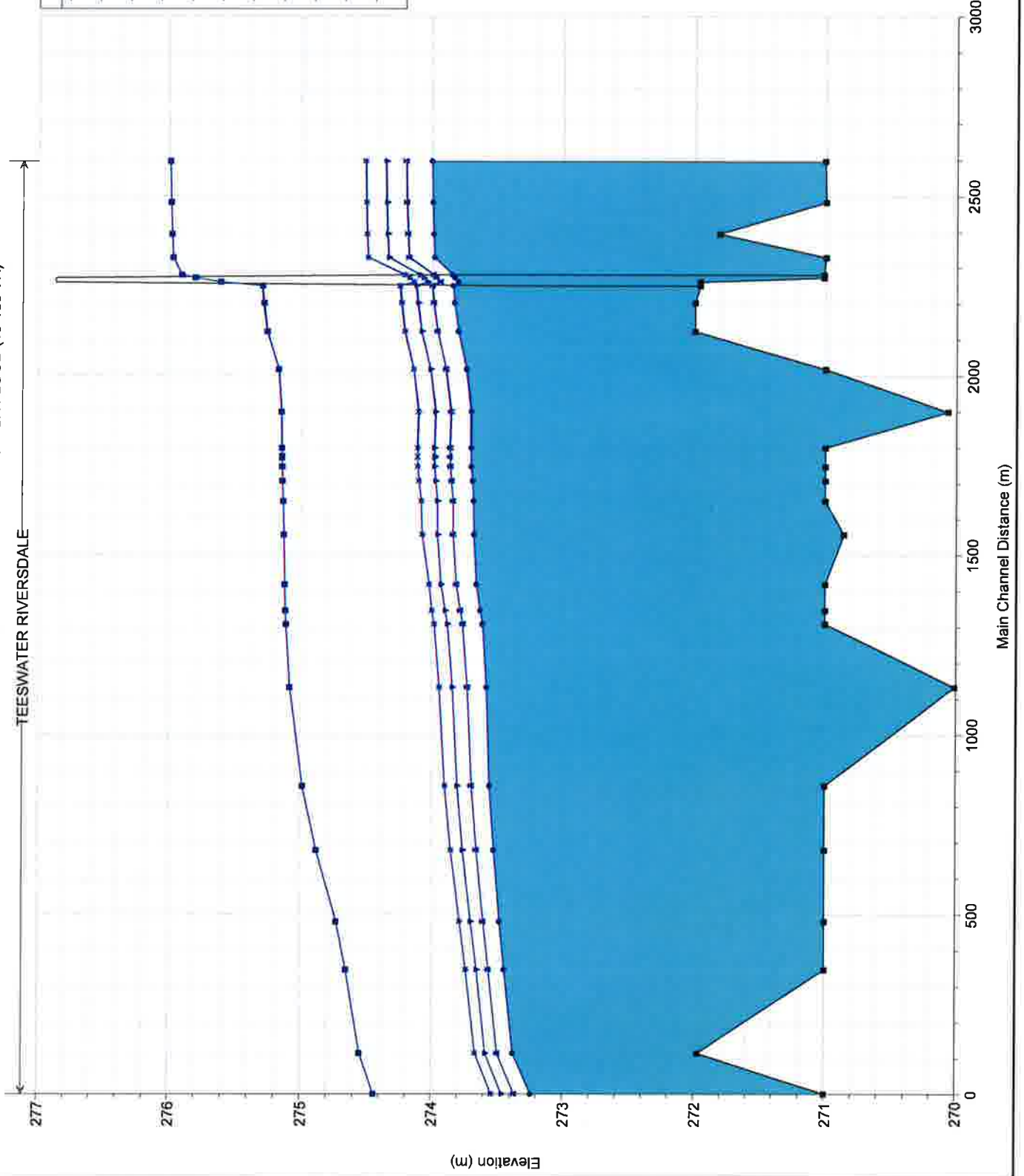
APPENDIX D: FLOODPLAIN MODELING – PROPOSED CONDITIONS

HEC-RAS Profile & Cross-Sectional Plots
Bridge No. 0002 Removal and Sideroad 20 Re-alignment (HEC-RAS Plan "PR")
Retention of Bridge No. 0002 and Sideroad 20 Re-alignment (HEC-RAS Plan "PR 2")

RIVERSDALE Plan: 1) EX-OFAT 1/23/2018 2) PR-OFAT 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

TEESWATER RIVERSDALE

| Legend | |
|-----------------------|--|
| WS REGIONAL - EX-OFAT | |
| WS REGIONAL - PR-OFAT | |
| WS 100-YR - EX-OFAT | |
| WS 100-YR - PR-OFAT | |
| WS 50-YR - PR-OFAT | |
| WS 50-YR - EX-OFAT | |
| WS 25-YR - PR-OFAT | |
| WS 25-YR - EX-OFAT | |
| WS 10-YR - PR-OFAT | |
| WS 10-YR - EX-OFAT | |
| Ground | |



RIVERSDALE
Plan: PR - OFAT INDEX 1/23/2018
Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 124

Legend

WS REGIONAL

WS 100-YR

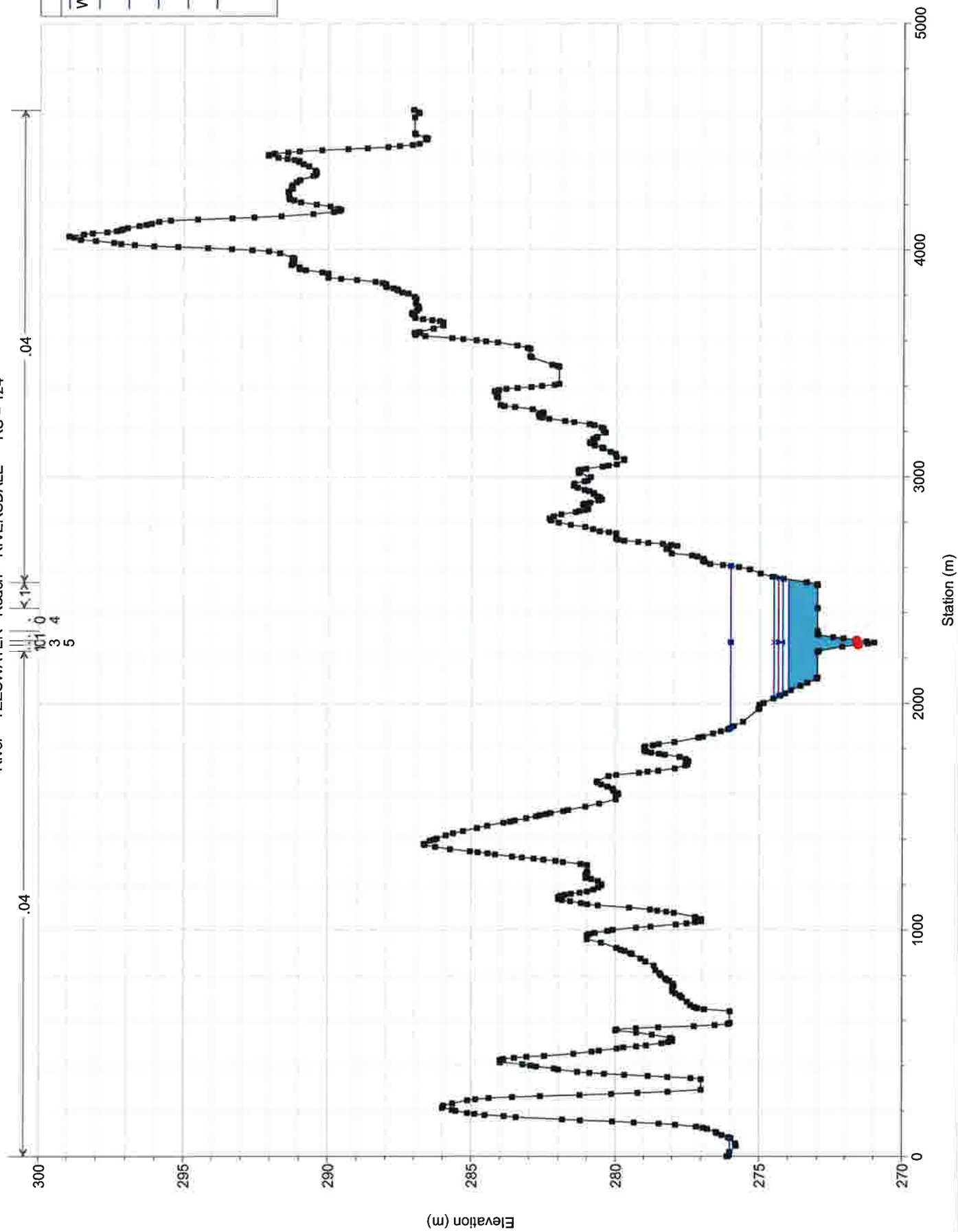
WS 50-YR

WS 25-YR

WS 10-YR

Ground

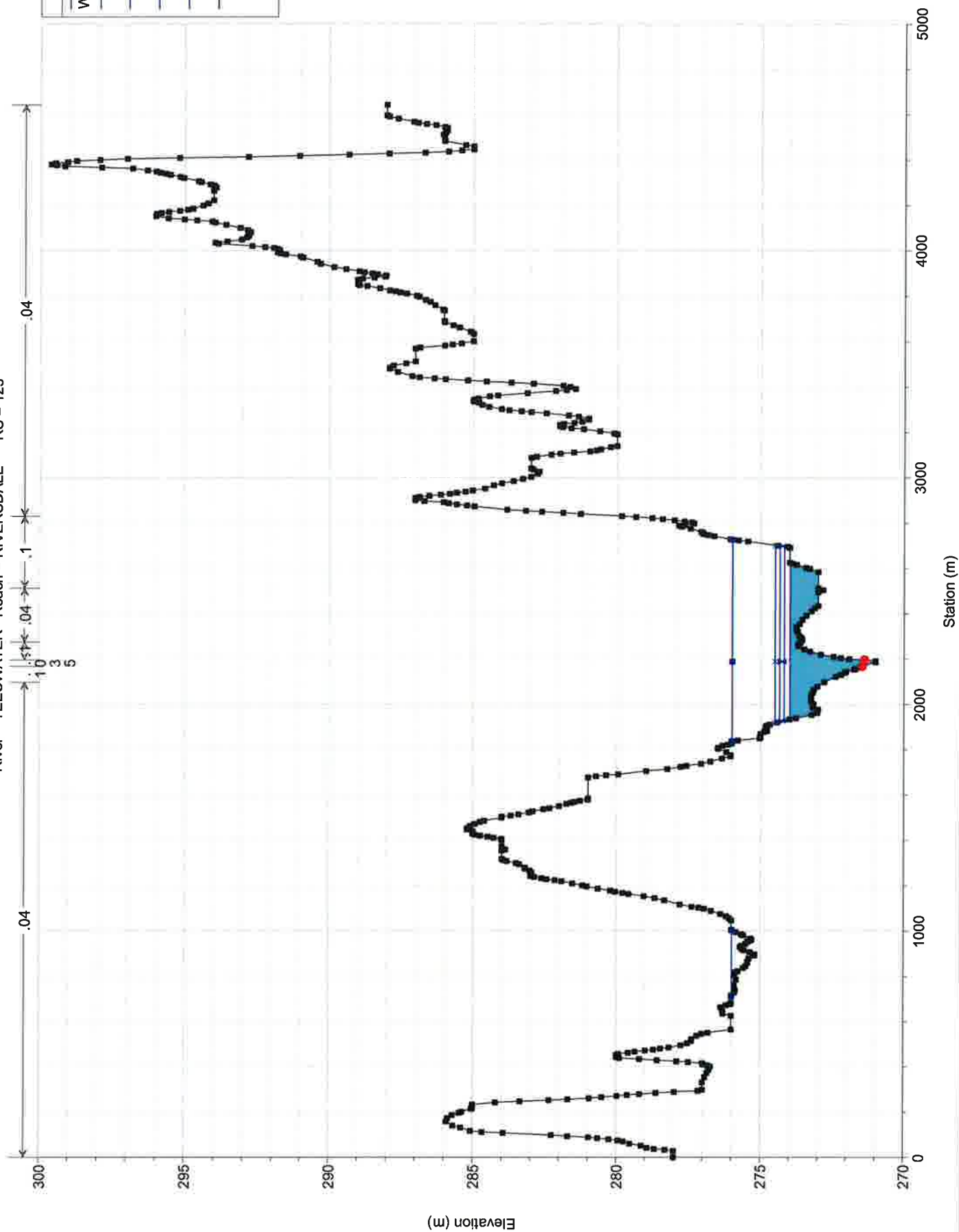
Bank Sta



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 123



| Legend | |
|-------------|---------------------------------|
| WS REGIONAL | Blue line with square markers |
| WS 100-YR | Blue line with 'x' markers |
| WS 50-YR | Blue line with triangle markers |
| WS 25-YR | Blue line with diamond markers |
| WS 10-YR | Blue line with circle markers |
| Ground | Black line with square markers |
| Bank Sta | Red dot |

RIVERSDALE
Plan: PR - OFAT INDEX
1/23/2018

Geom: PROPOSED
Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER
Reach = RIVERSDALE
RS = 122

Legend

WS REGIONAL

WS 100-YR

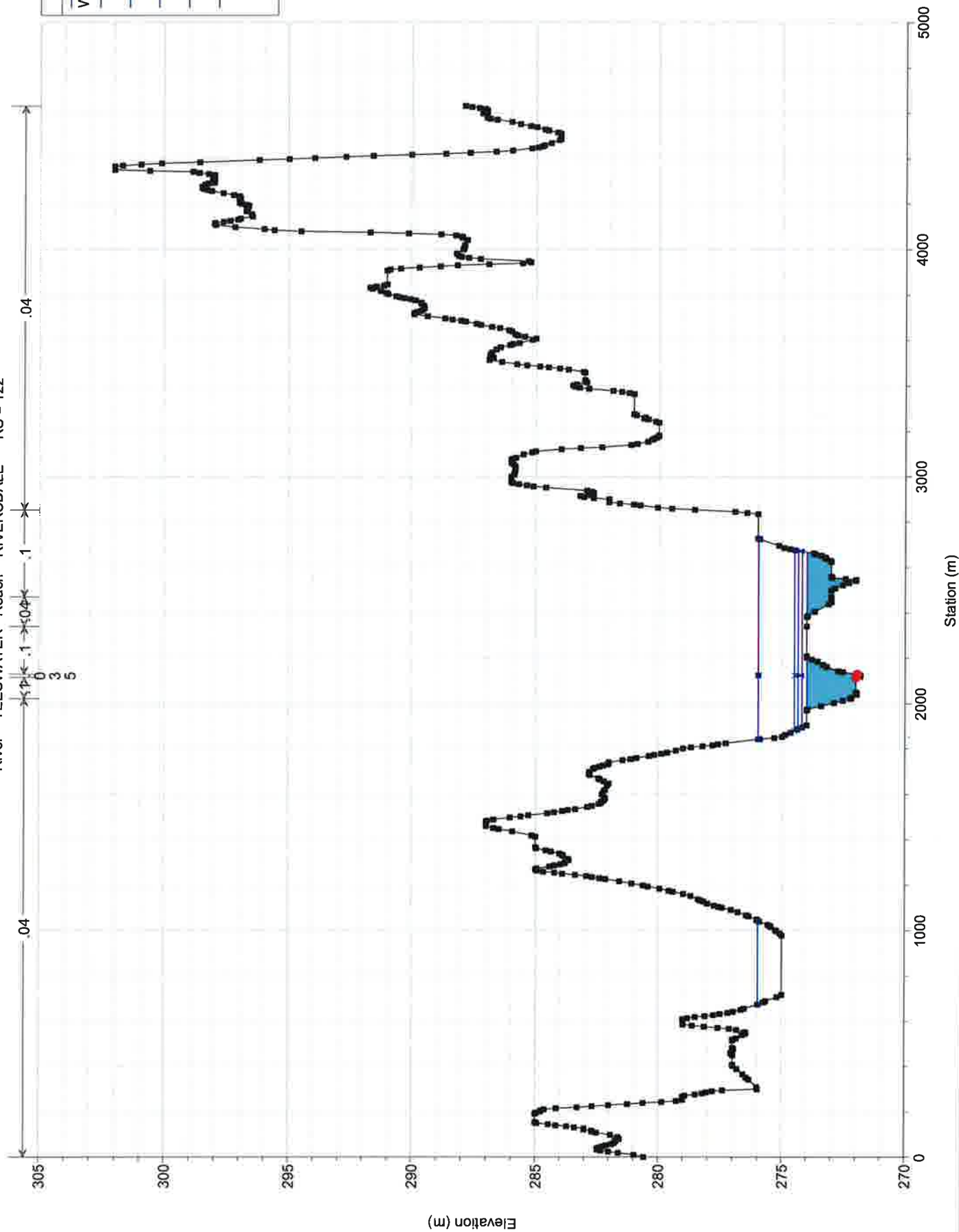
WS 50-YR

WS 25-YR

WS 10-YR

Ground

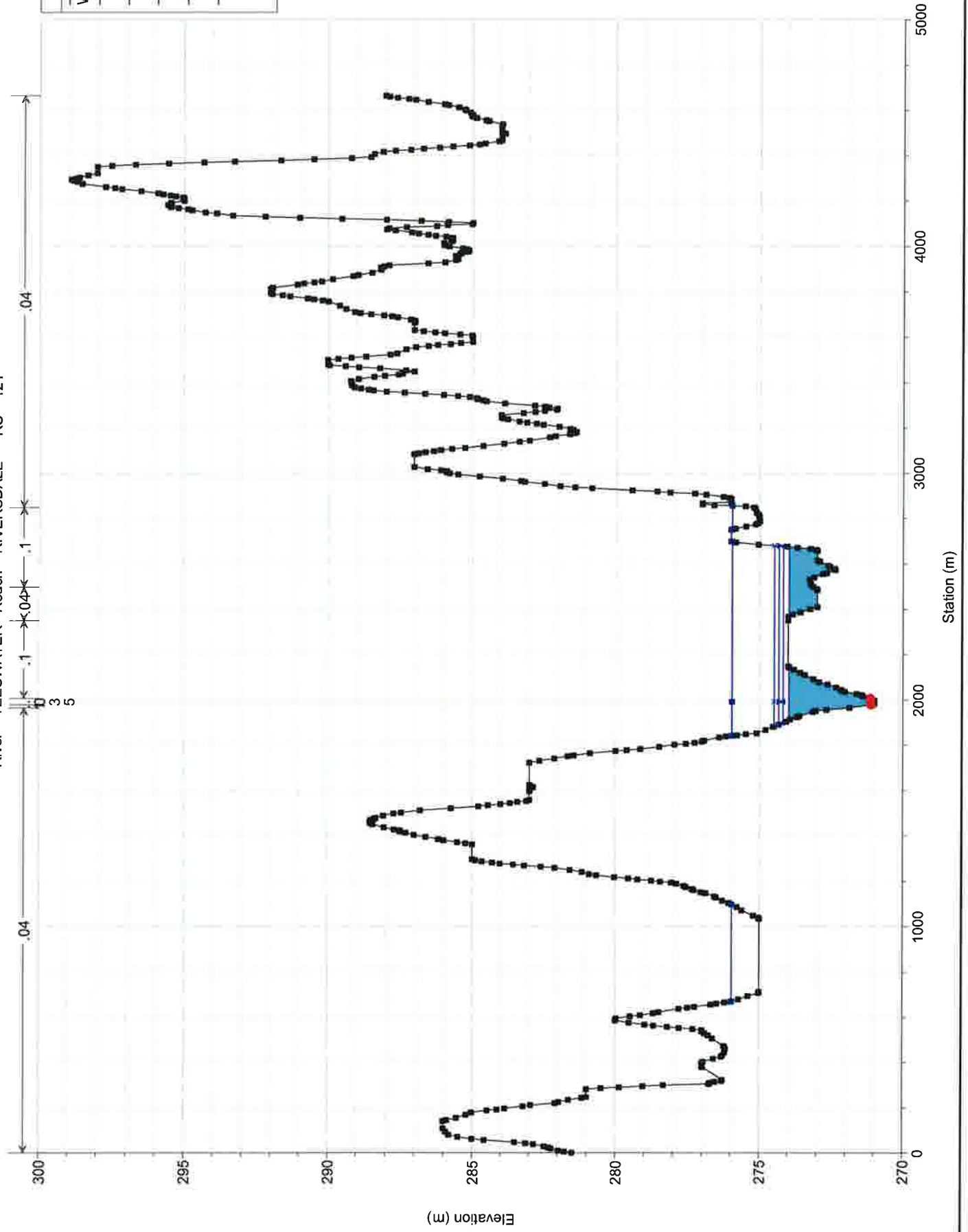
Bank Sta



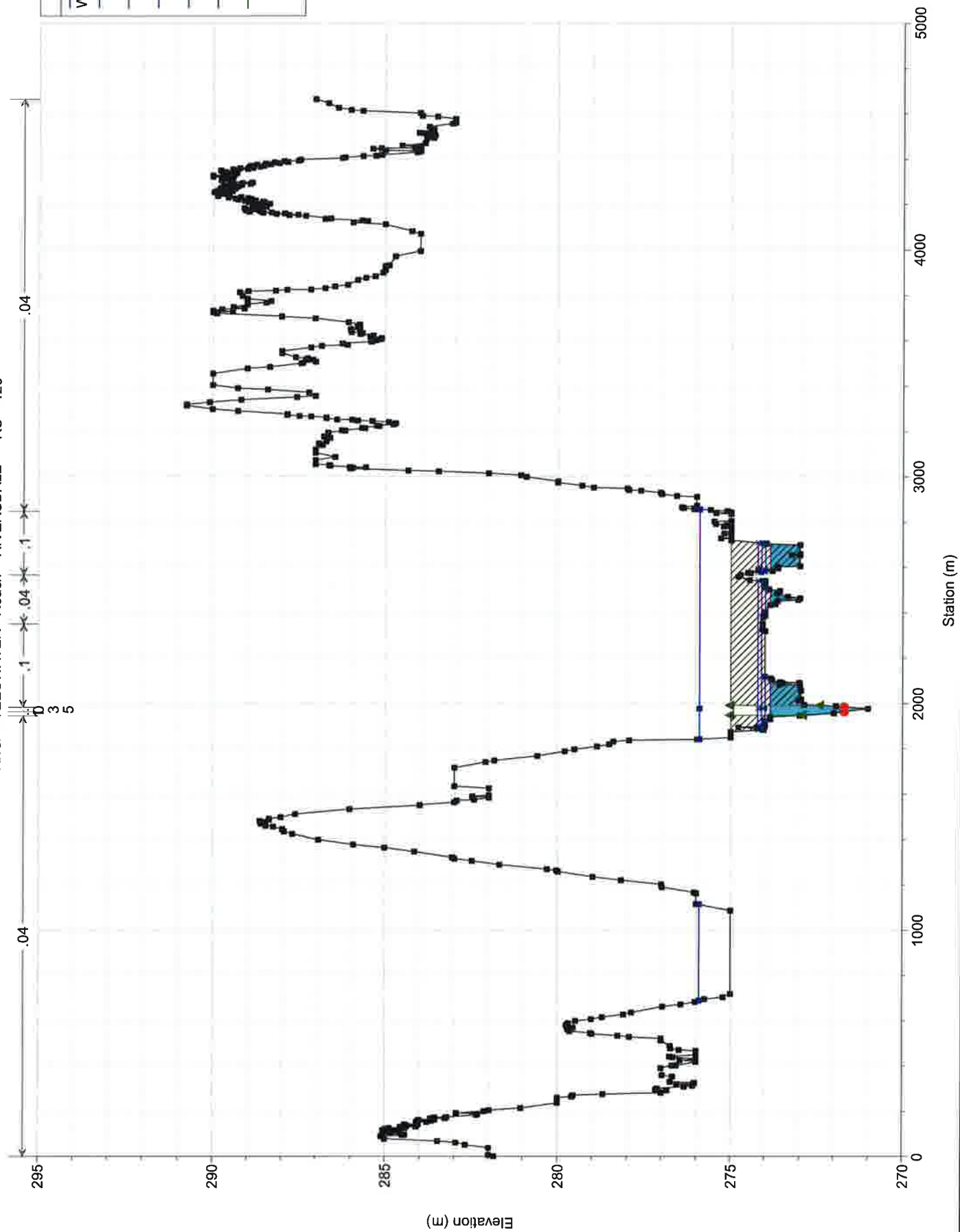
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 121



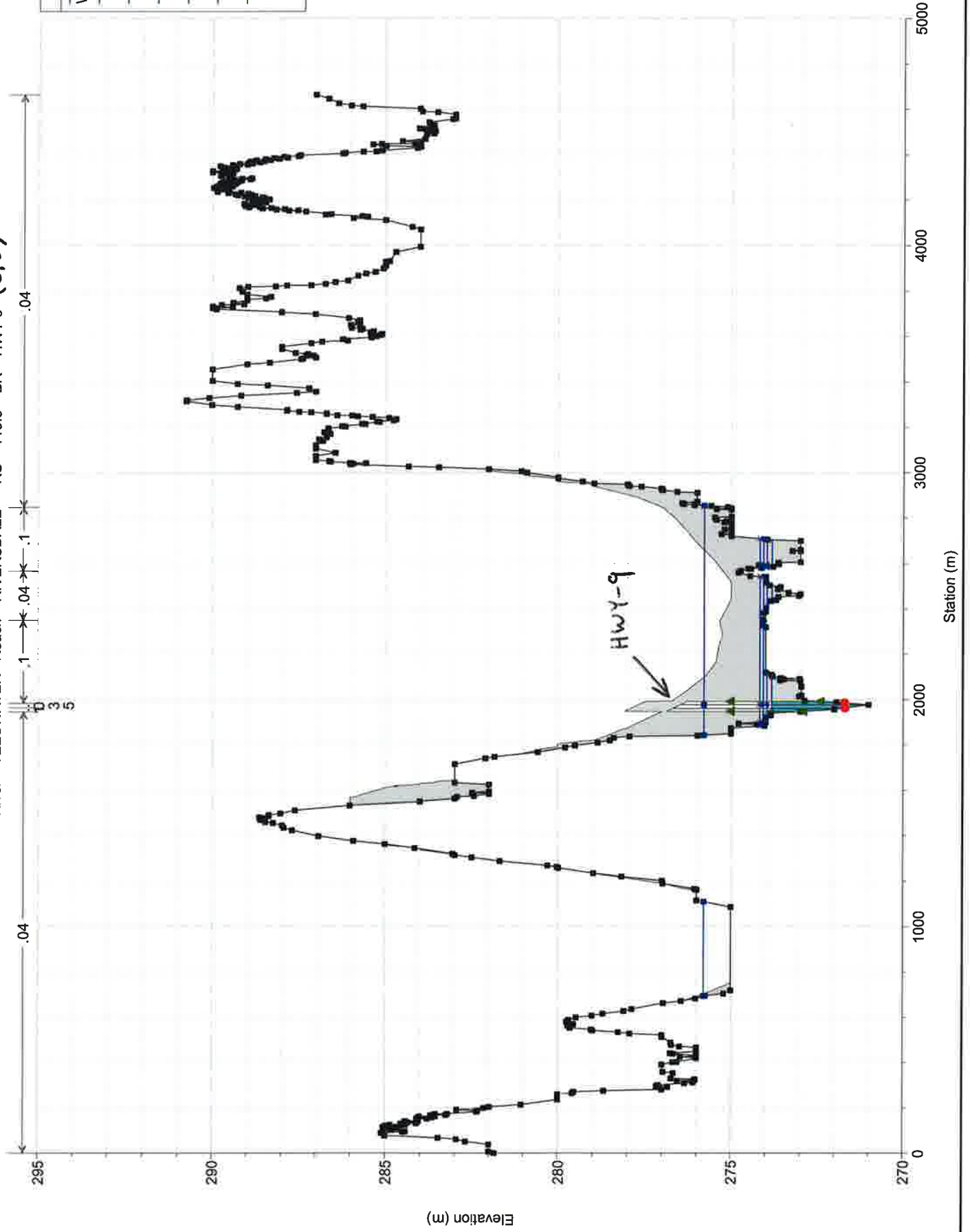
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 120



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 119.5 BR HWY 9 (u/s)

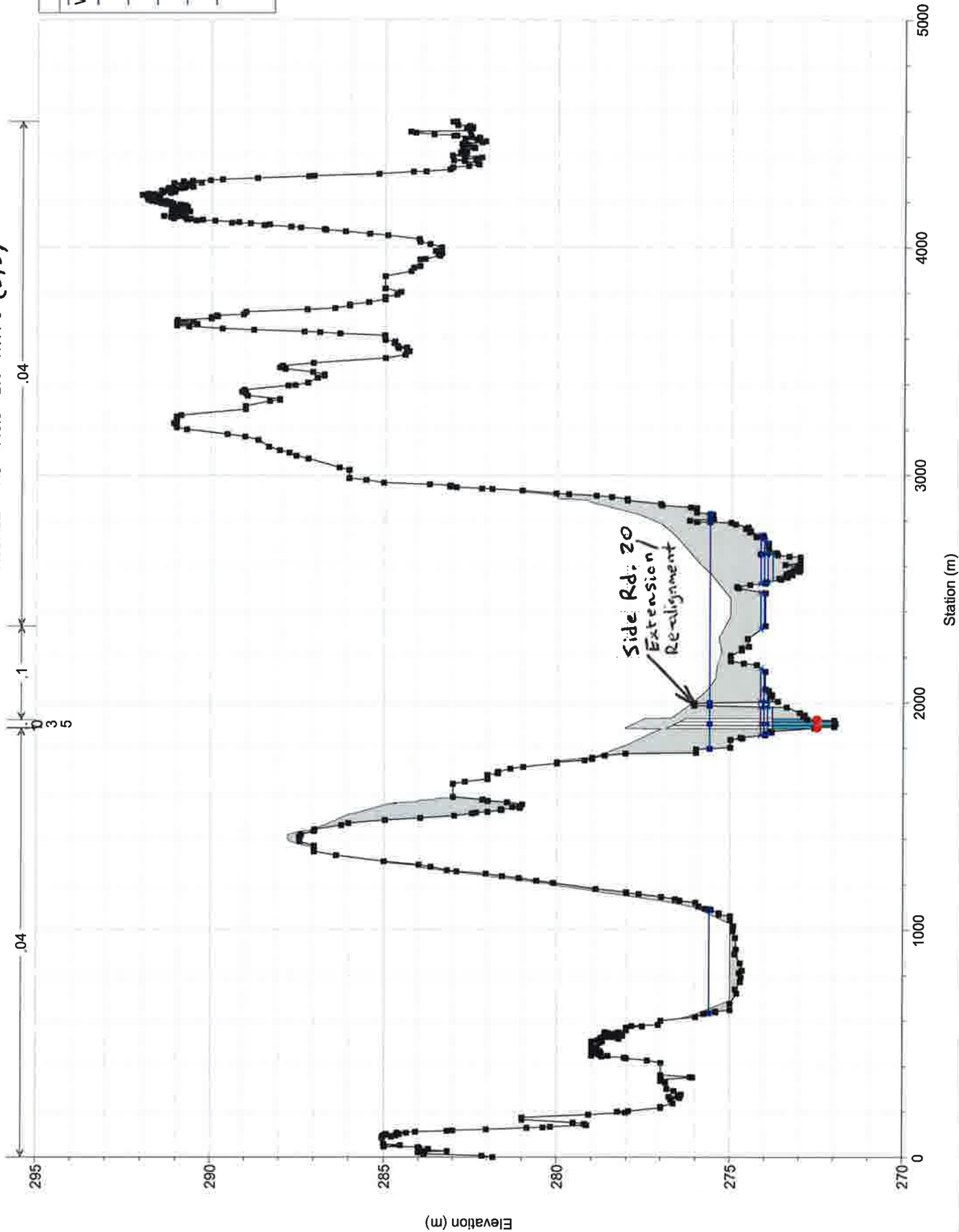


| Legend | |
|-------------|---|
| WS REGIONAL | ● |
| WS 100-YR | ● |
| WS 50-YR | ● |
| WS 25-YR | ● |
| WS 10-YR | ● |
| Ground | ■ |
| Bank Sta | ● |

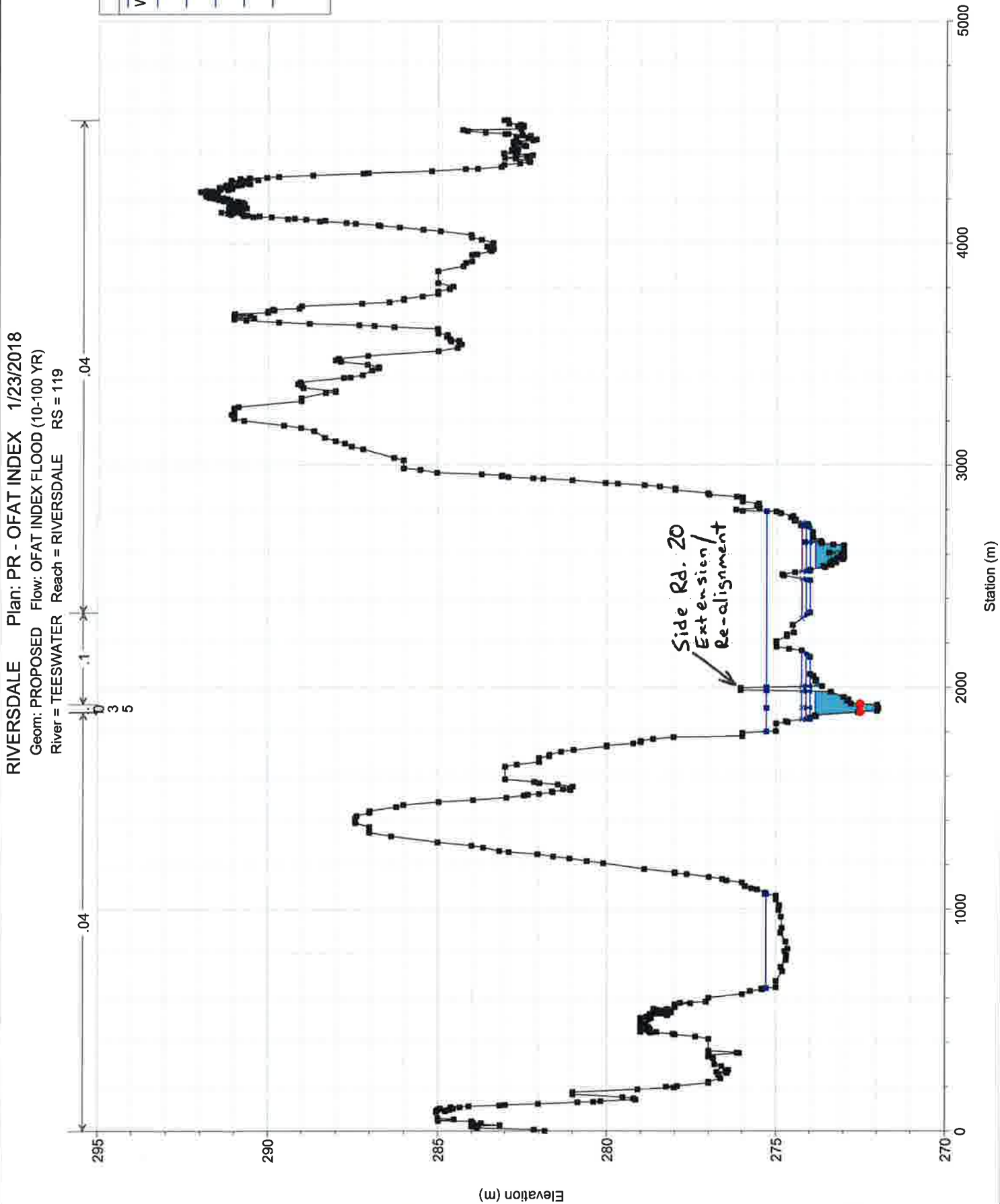
RIVERSDALE
Plan: PR - OFAT INDEX
1/23/2018

Geom: PROPOSED
Flow: OFAT INDEX FLOOD (10-100 YR)

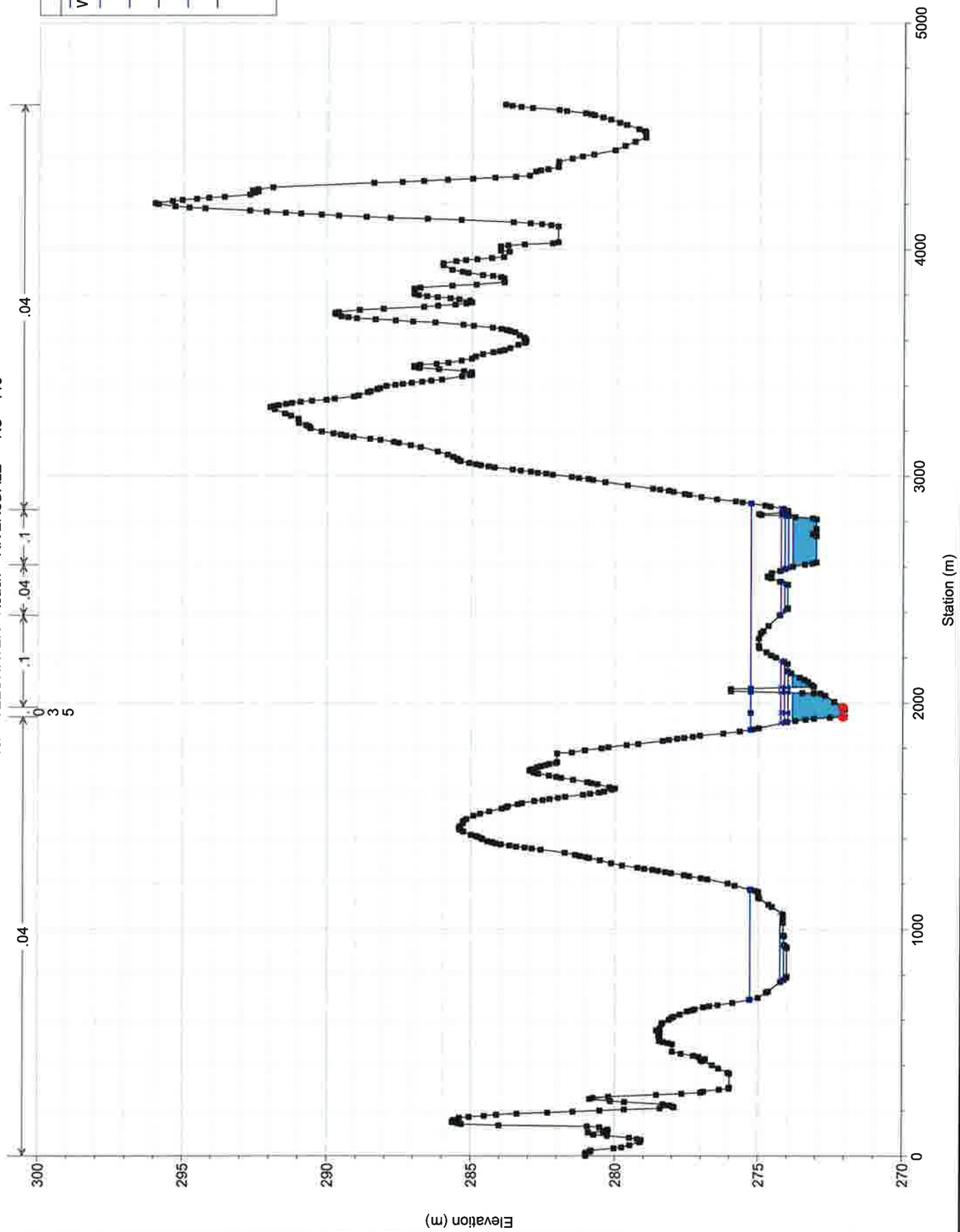
River = TEESWATER
Reach = RIVERSDALE
RS = 119.5
BR
HWY 9 (D/S)



| Legend | |
|-------------|---|
| WS REGIONAL | — |
| WS 100-YR | — |
| WS 50-YR | — |
| WS 25-YR | — |
| WS 10-YR | — |
| Ground | — |
| Bank Sta | ● |



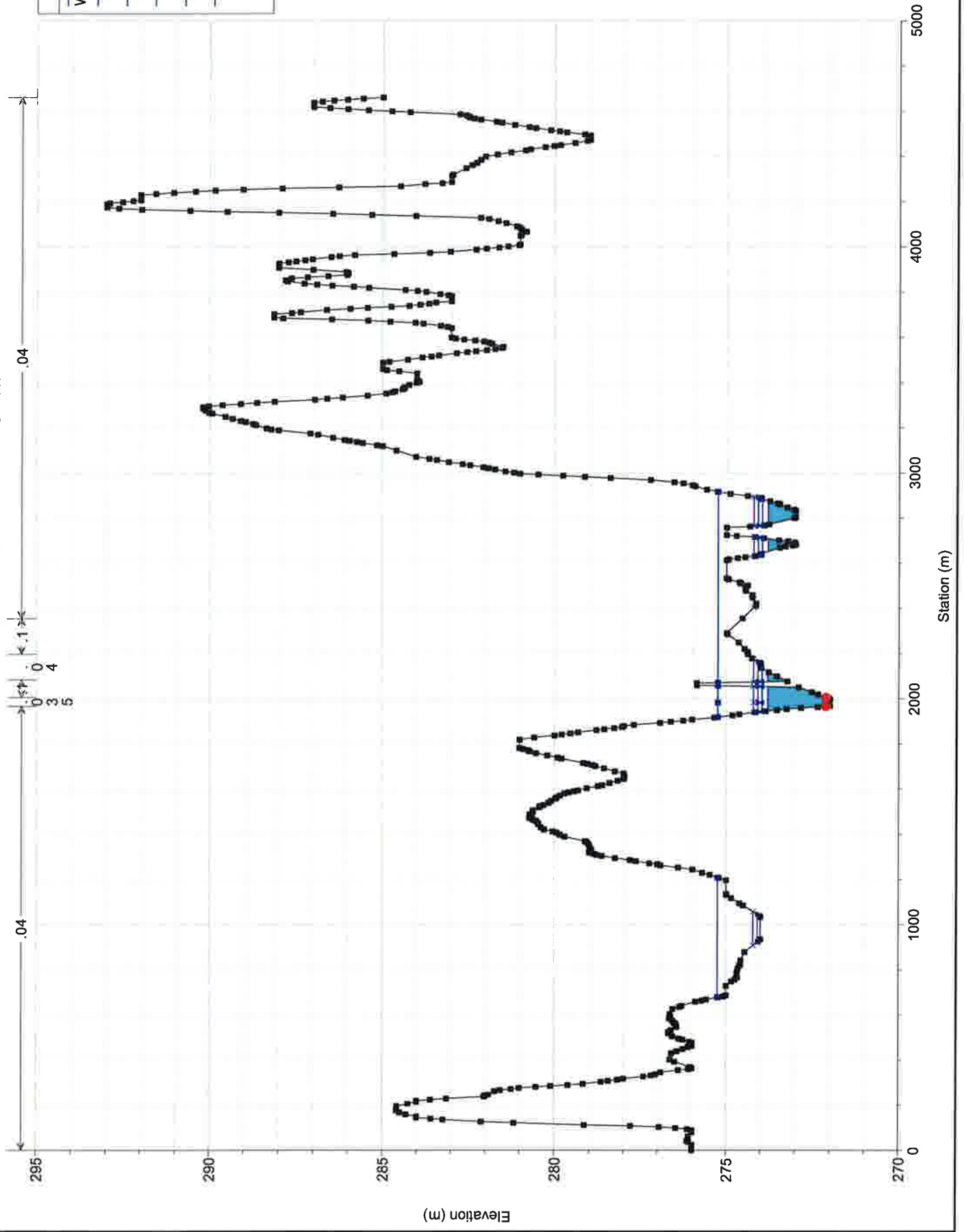
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 118



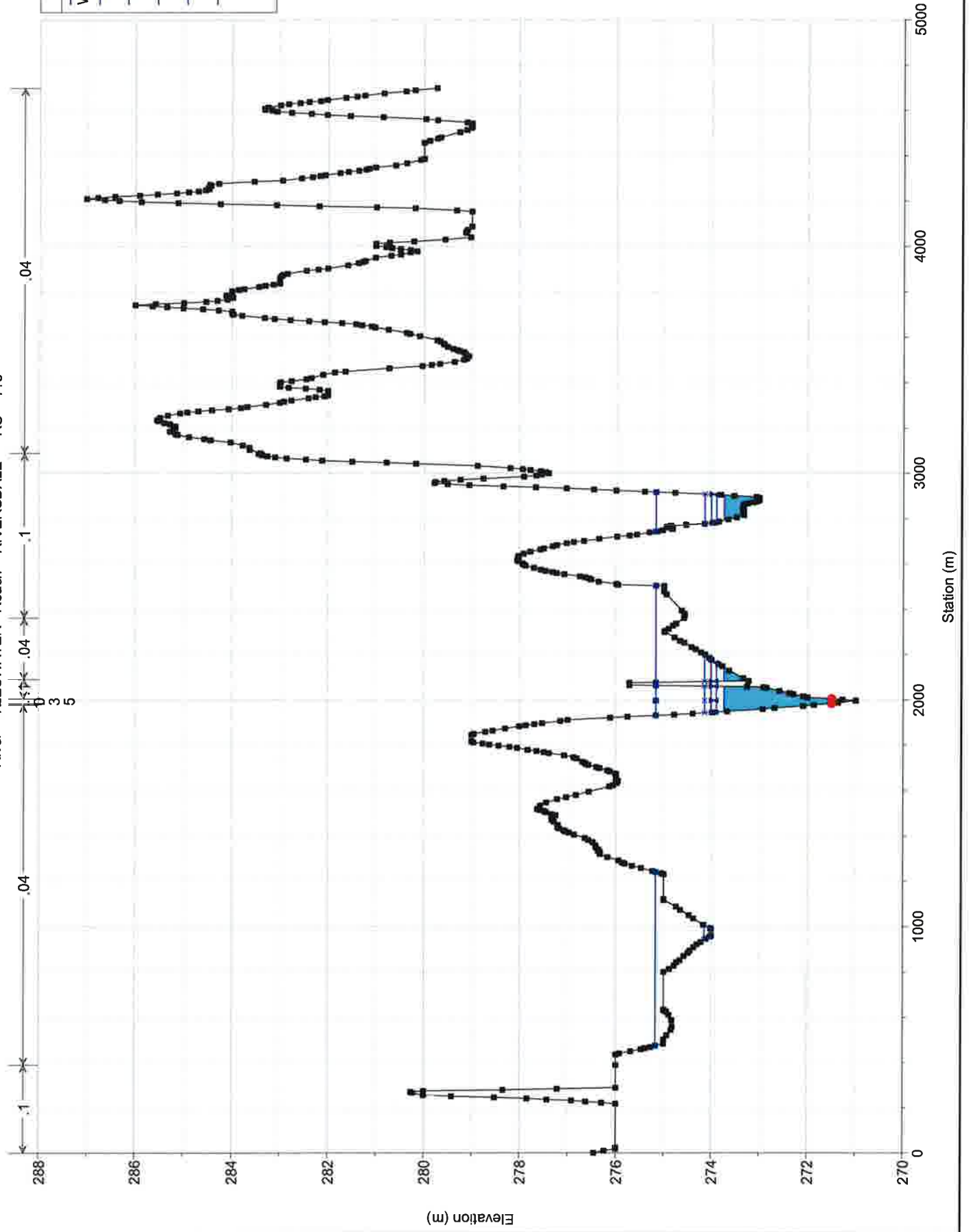
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

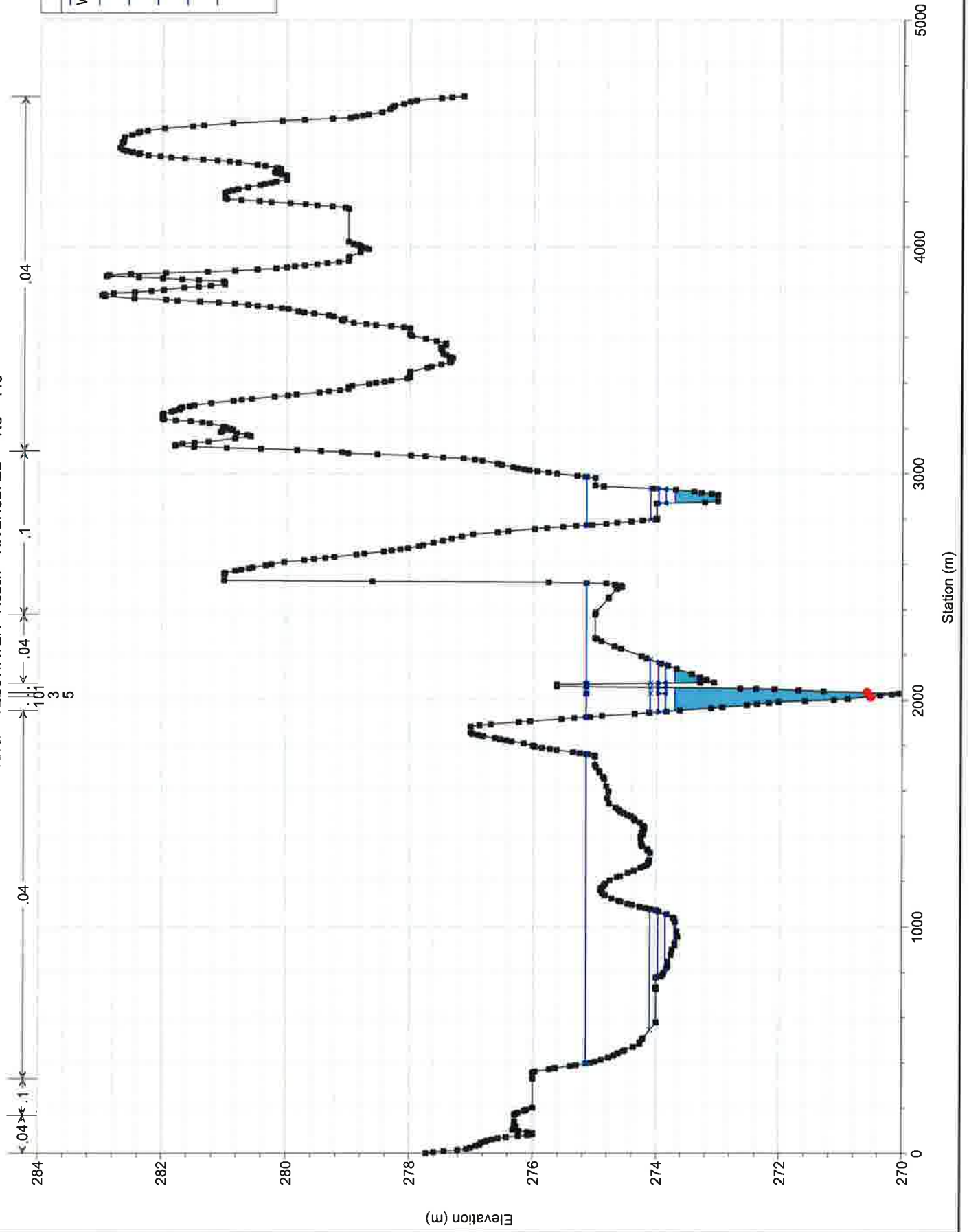
River = TEESWATER Reach = RIVERSDALE RS = 117



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 116



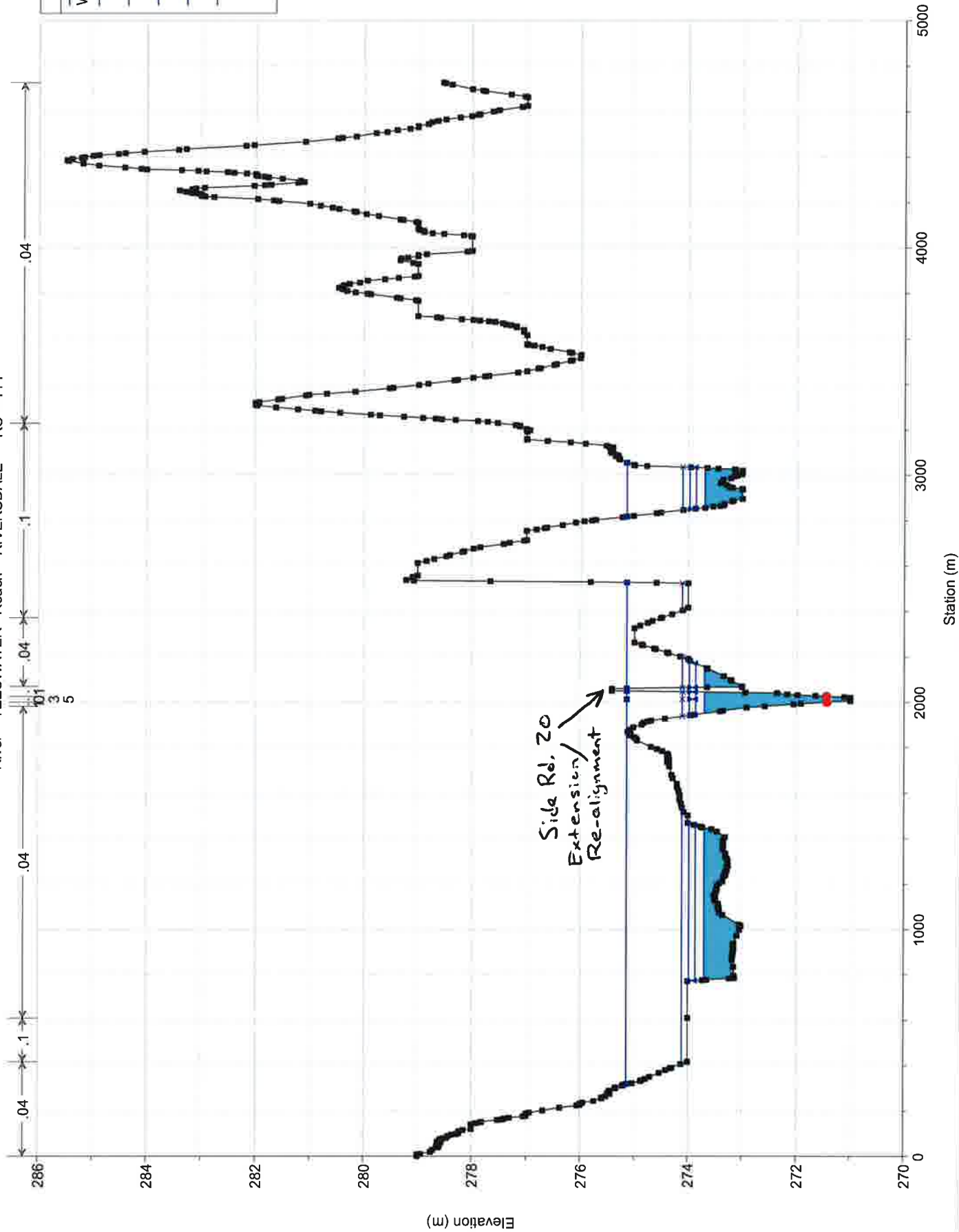
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 115



RIVERSDALE
Plan: PR - OFAT INDEX
1/23/2018

Geom: PROPOSED
Flow: OFAT INDEX FLOOD (10-100 YR)

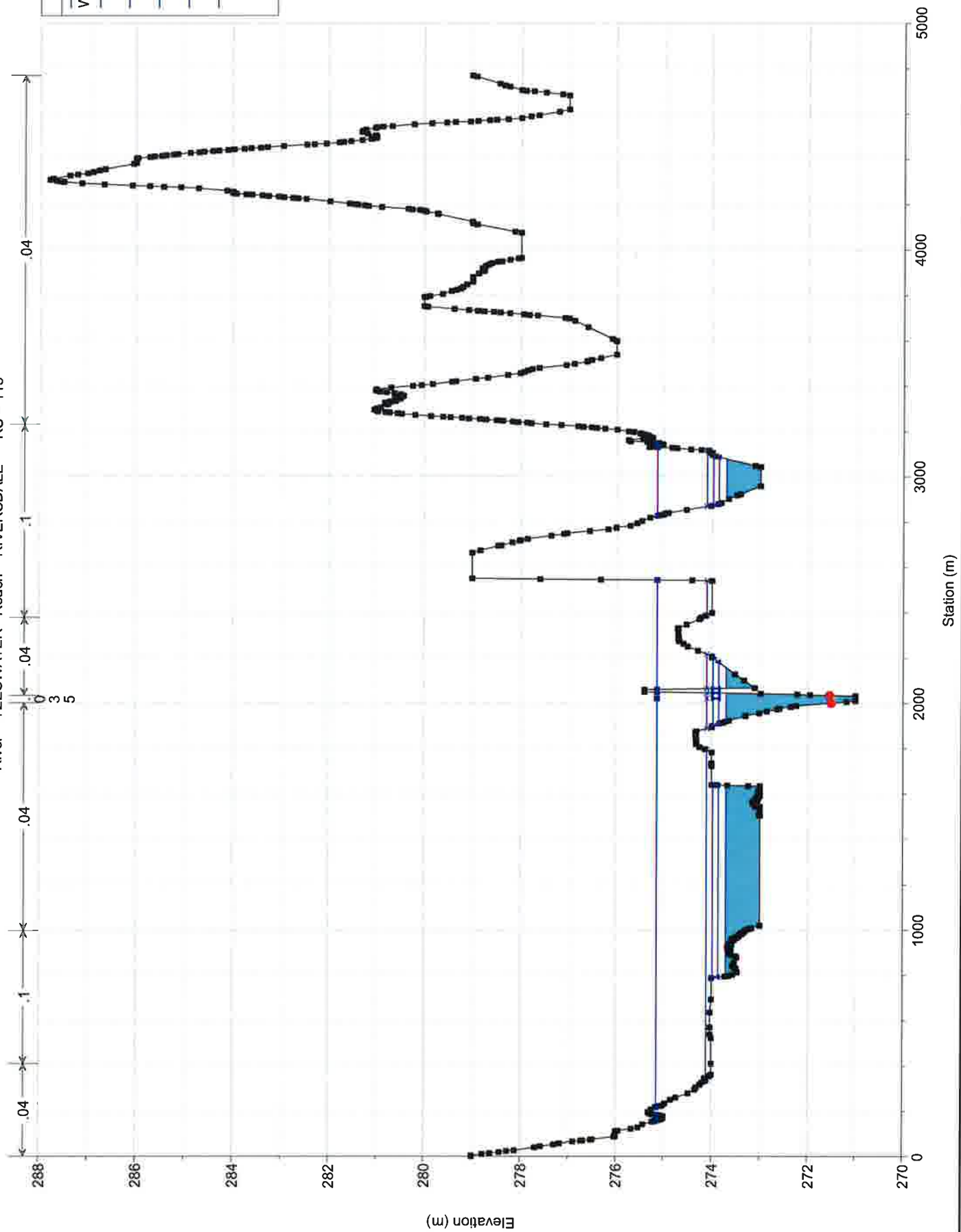
River = TEESWATER
Reach = RIVERSDALE
RS = 114



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 113

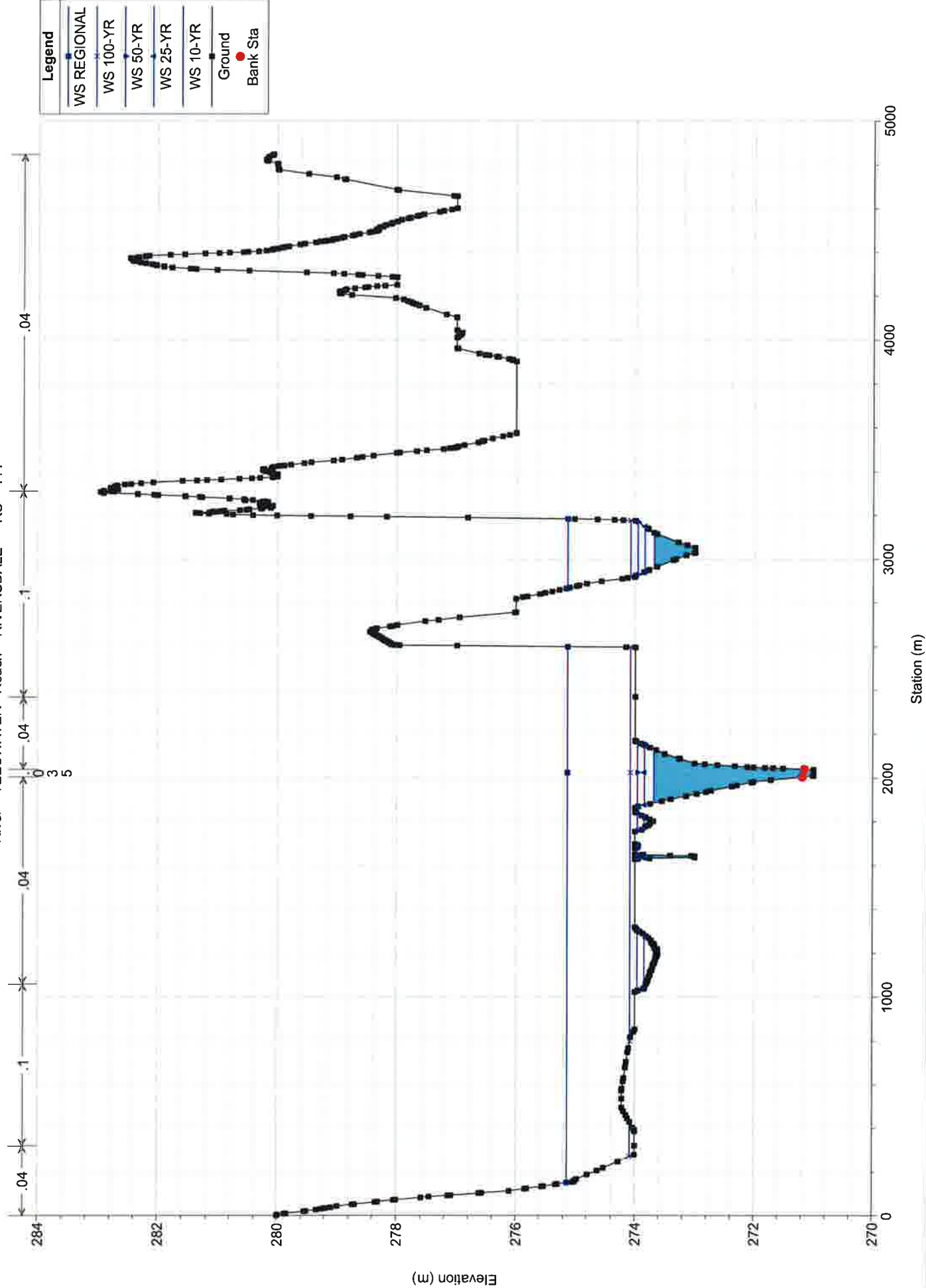


Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 112

| | | |
|------------|-----------------------|-----------|
| RIVERSDALE | Plan: PR - OFAT INDEX | 1/23/2018 |
|------------|-----------------------|-----------|

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

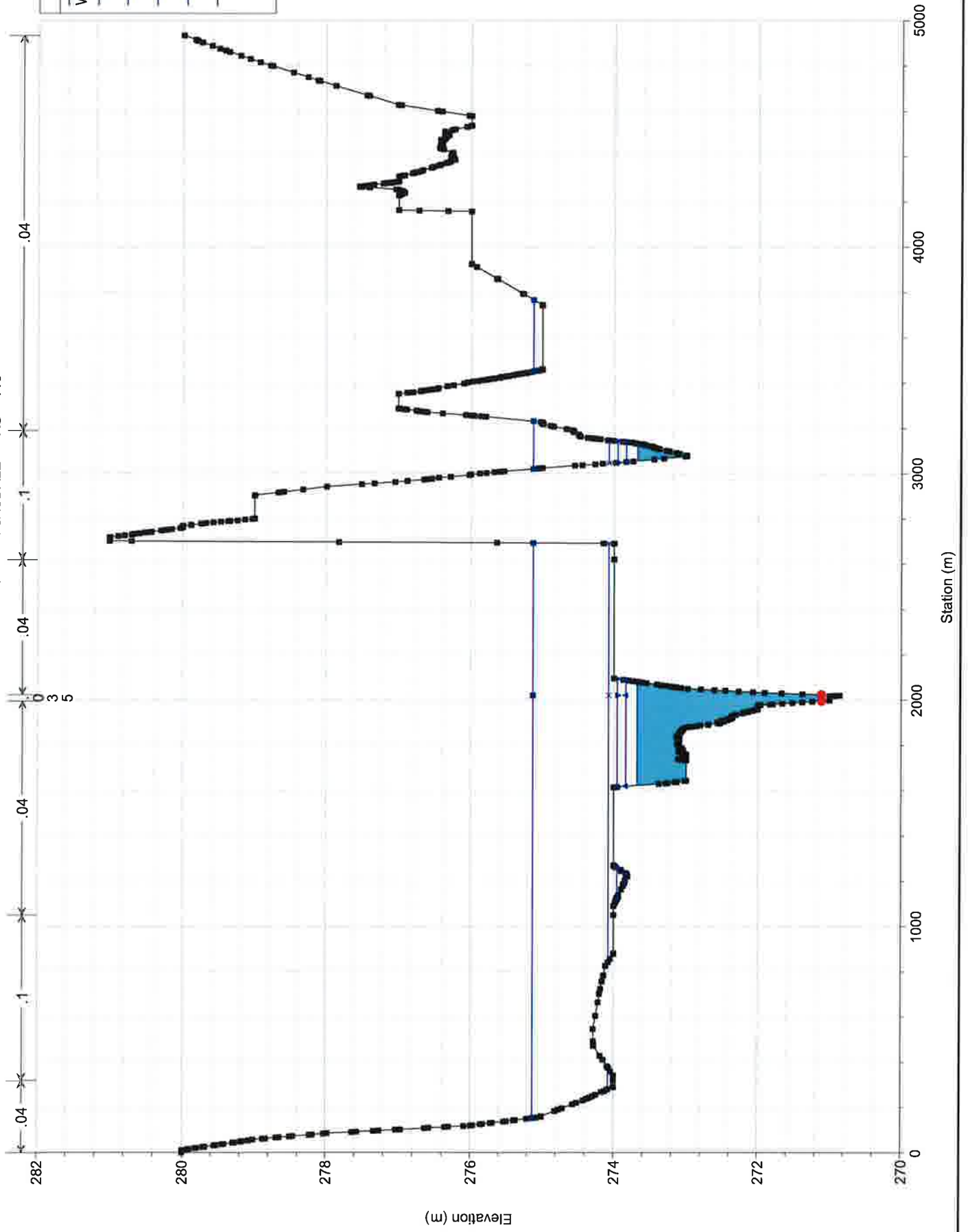
River = TEESWATER Reach = RIVERSDALE RS = 111



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

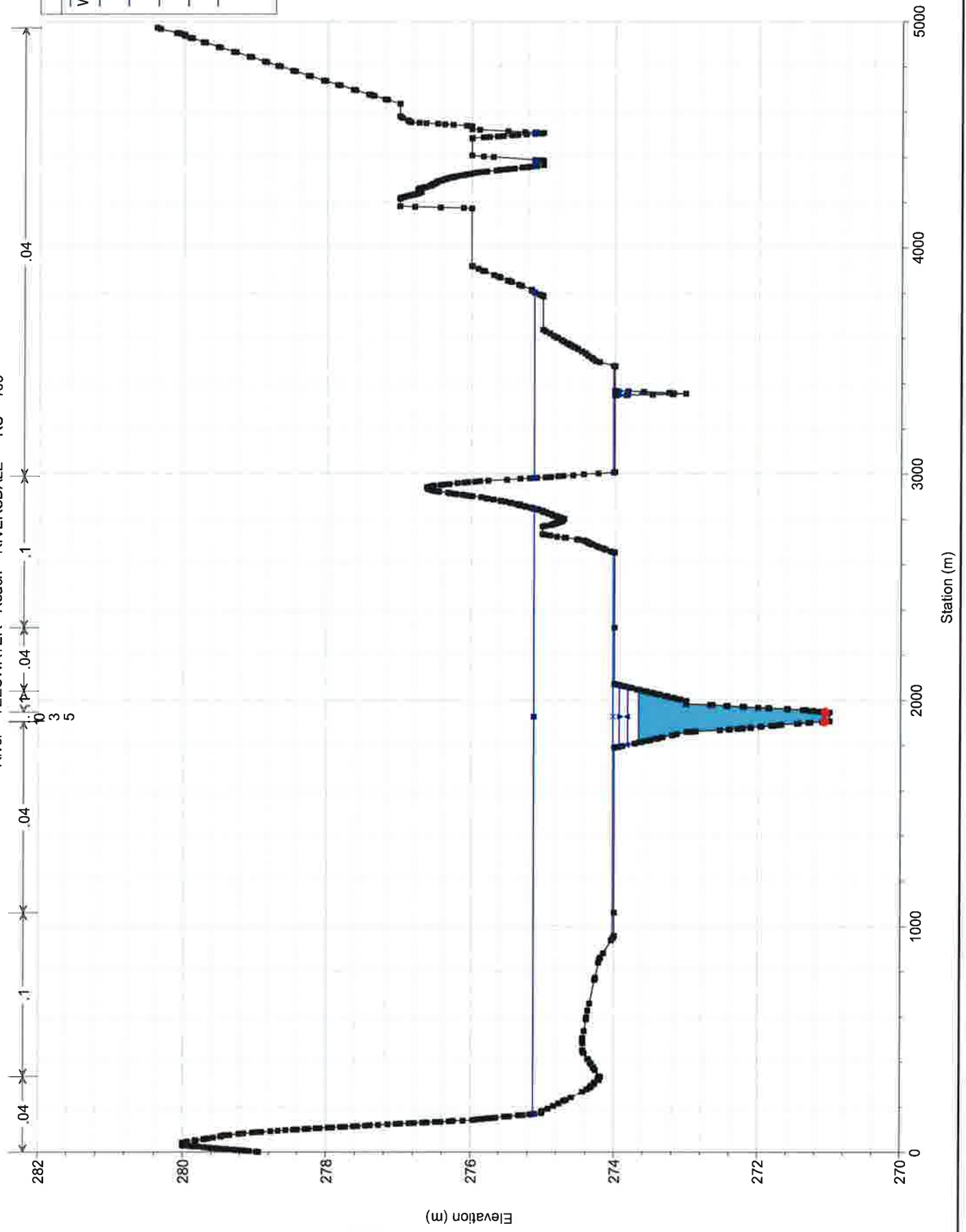
River = TEESWATER Reach = RIVERSDALE RS = 110



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

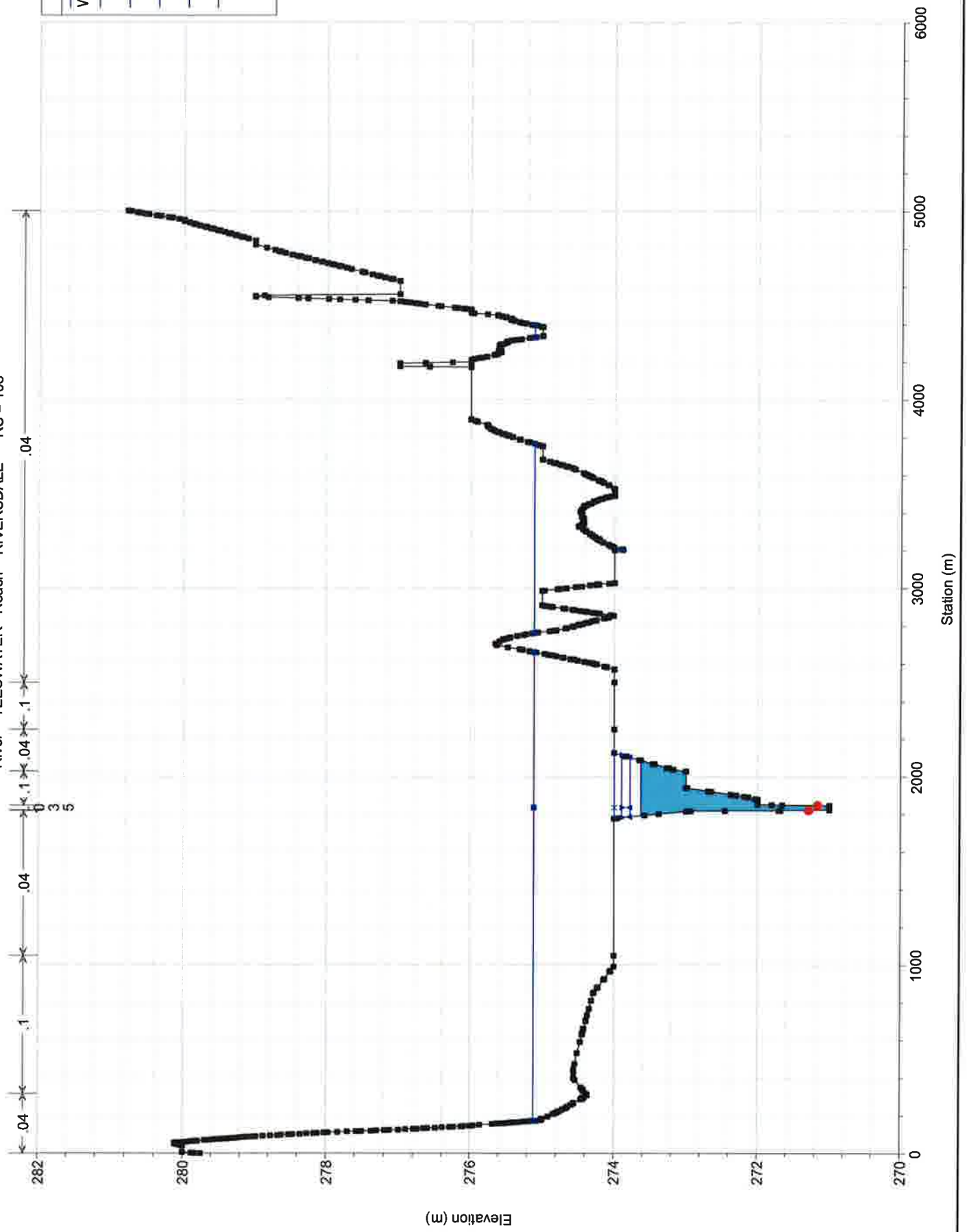
River = TEESWATER Reach = RIVERSDALE RS = 109



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

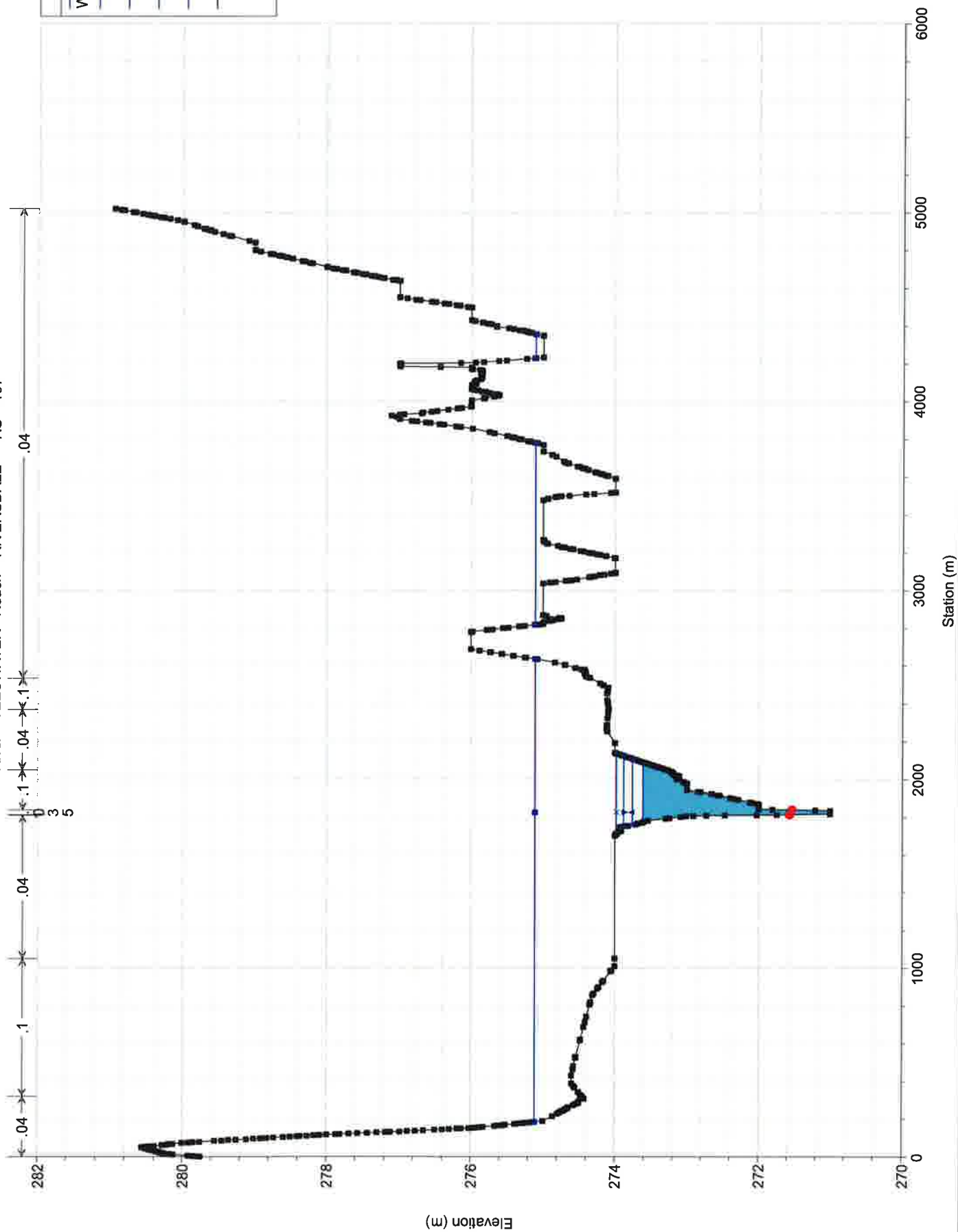
River = TEESWATER Reach = RIVERSDALE RS = 108



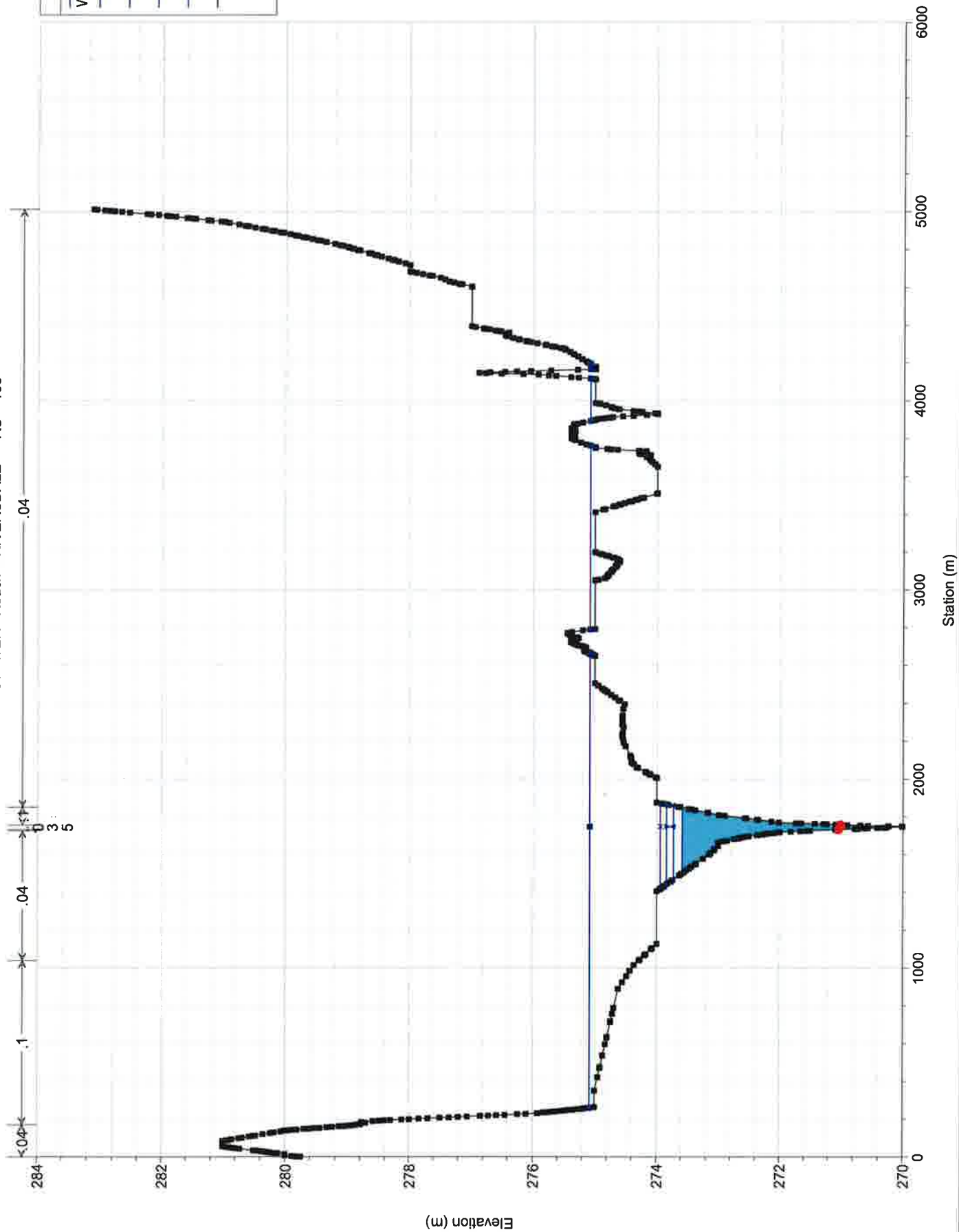
| | | |
|------------|-----------------------|-----------|
| RIVERSDALE | Plan: PR - OFAT INDEX | 1/23/2018 |
|------------|-----------------------|-----------|

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 107



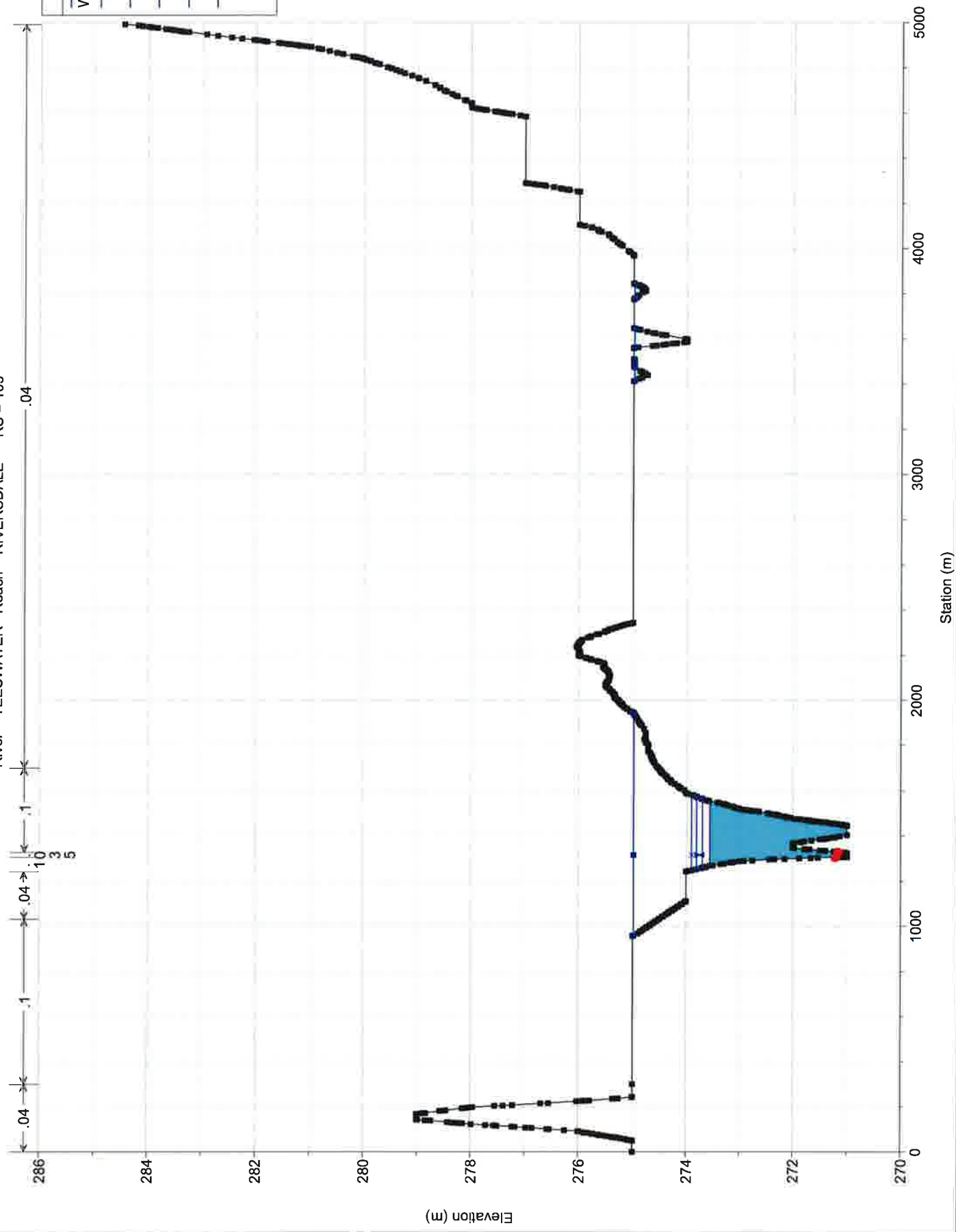
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 106



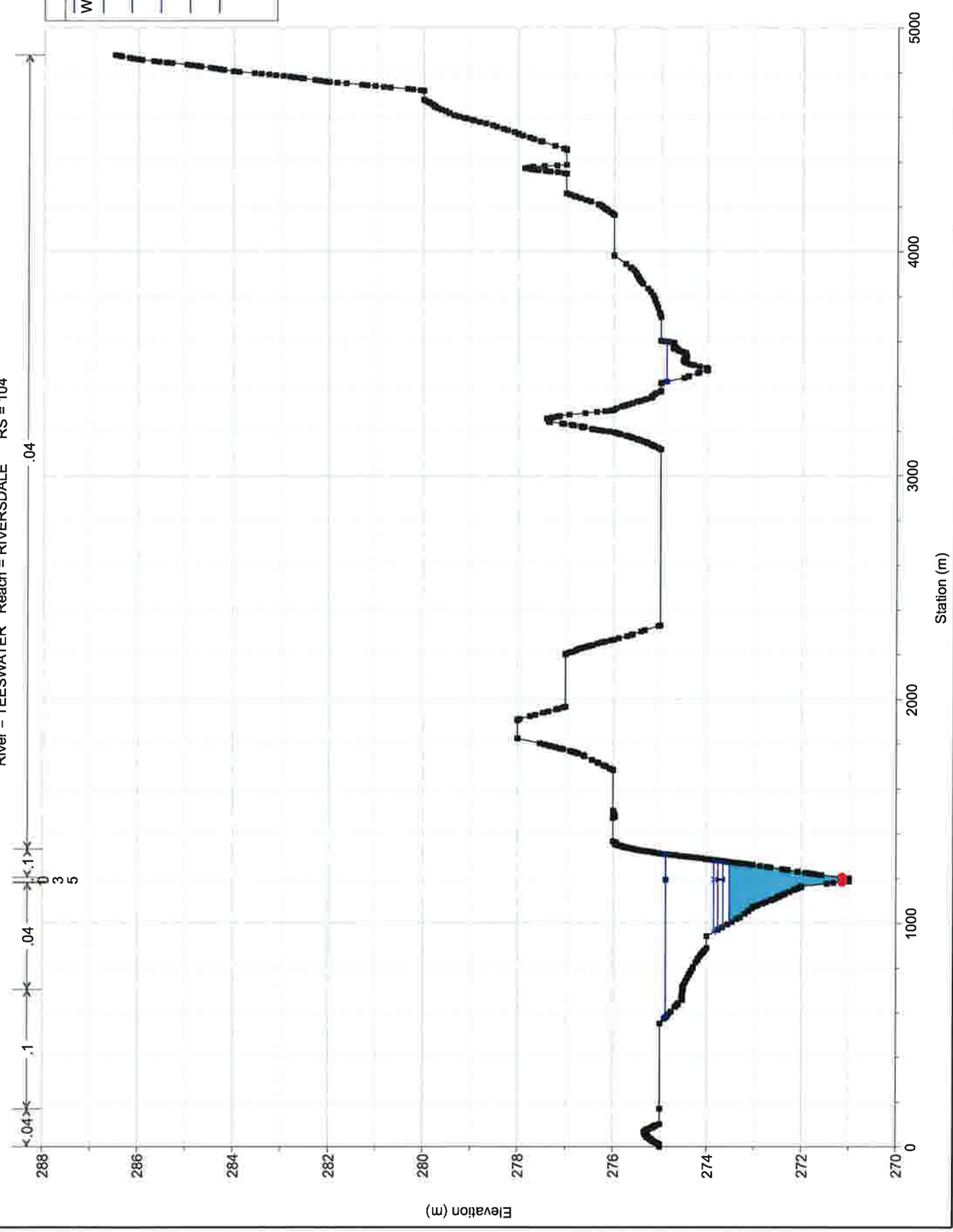
| | | |
|------------|-----------------------|-----------|
| RIVERSDALE | Plan: PR - OFAT INDEX | 1/23/2018 |
|------------|-----------------------|-----------|

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

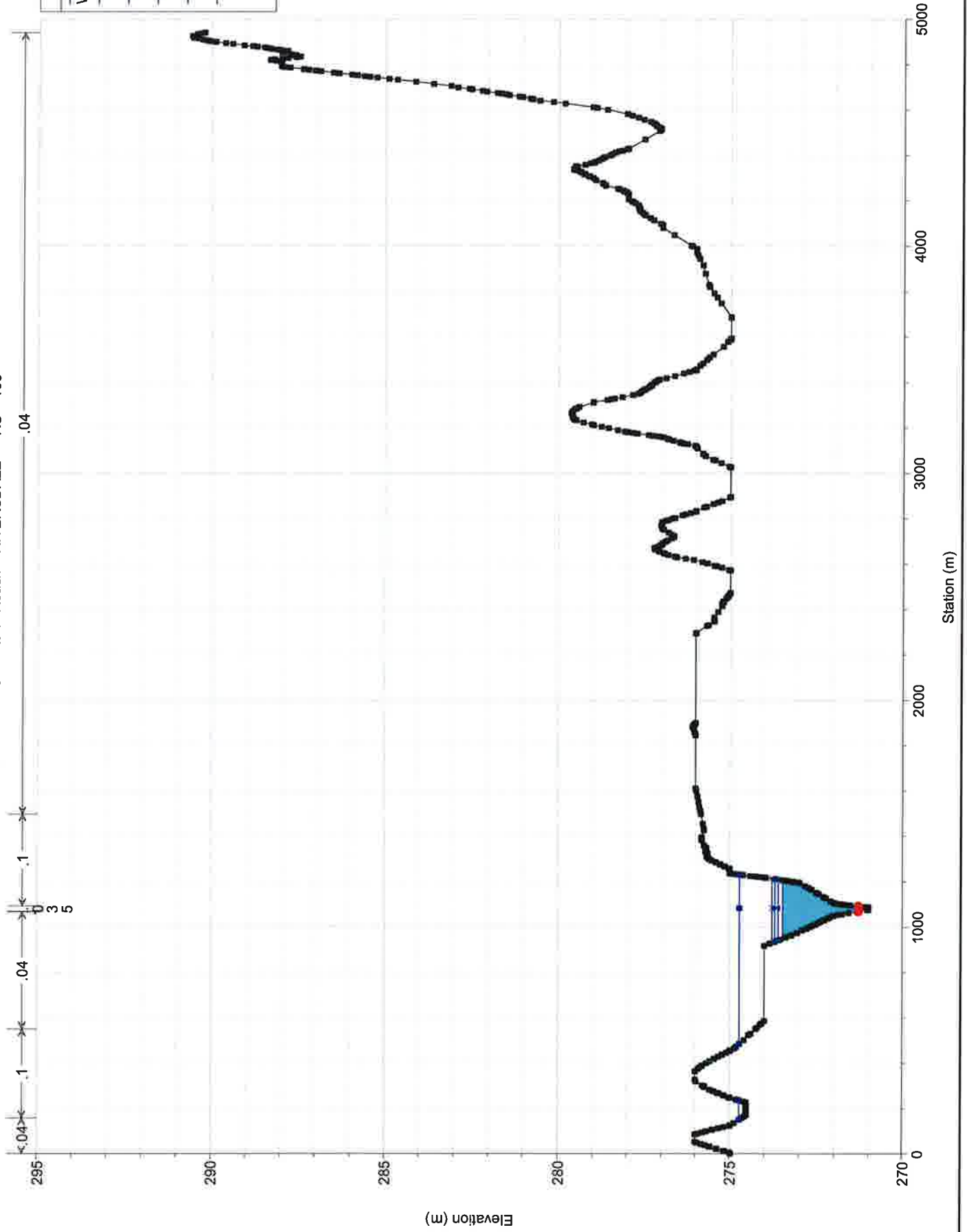
River = TEESWATER Reach = RIVERSDALE RS = 105



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 104



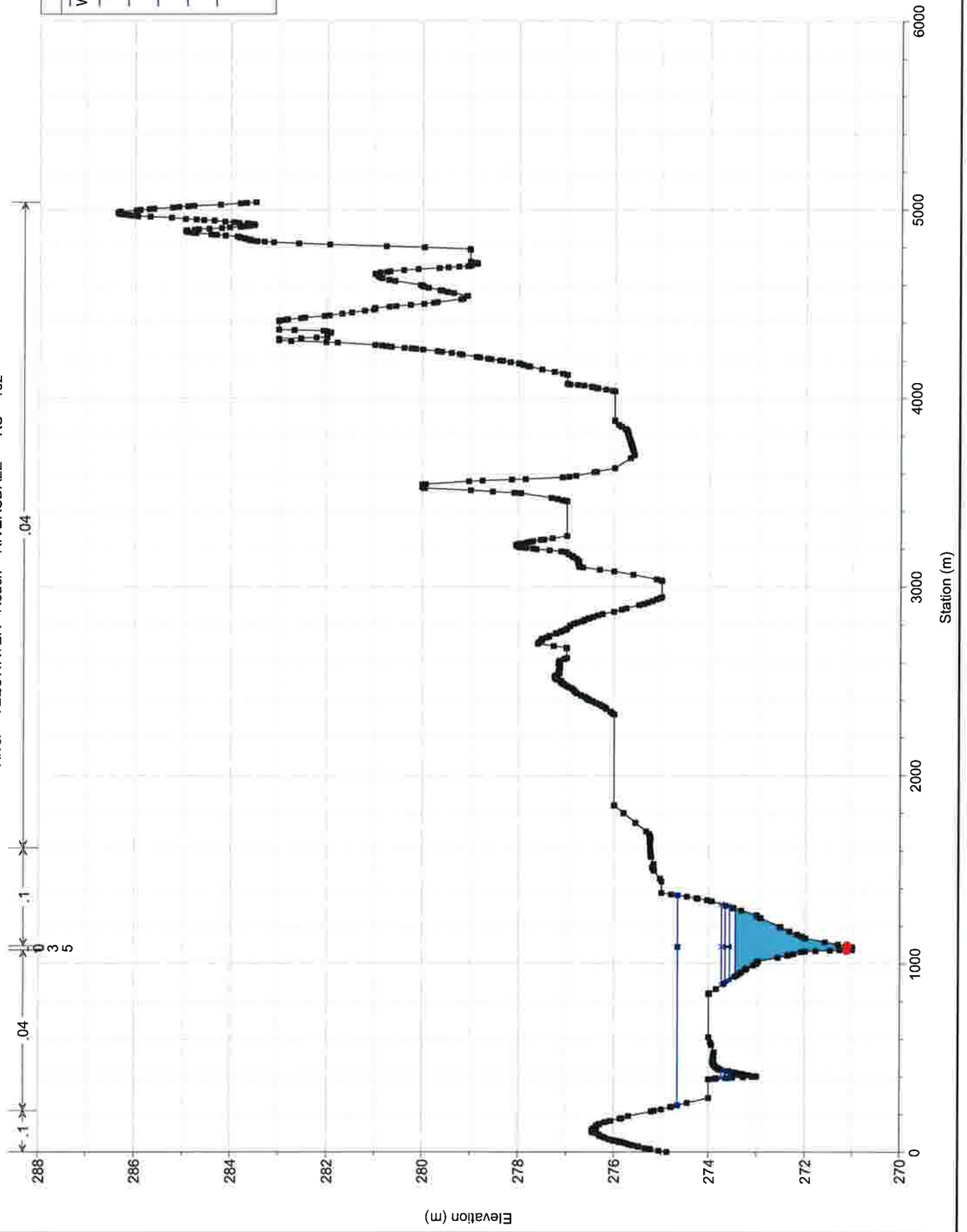
RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018
 Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 103



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

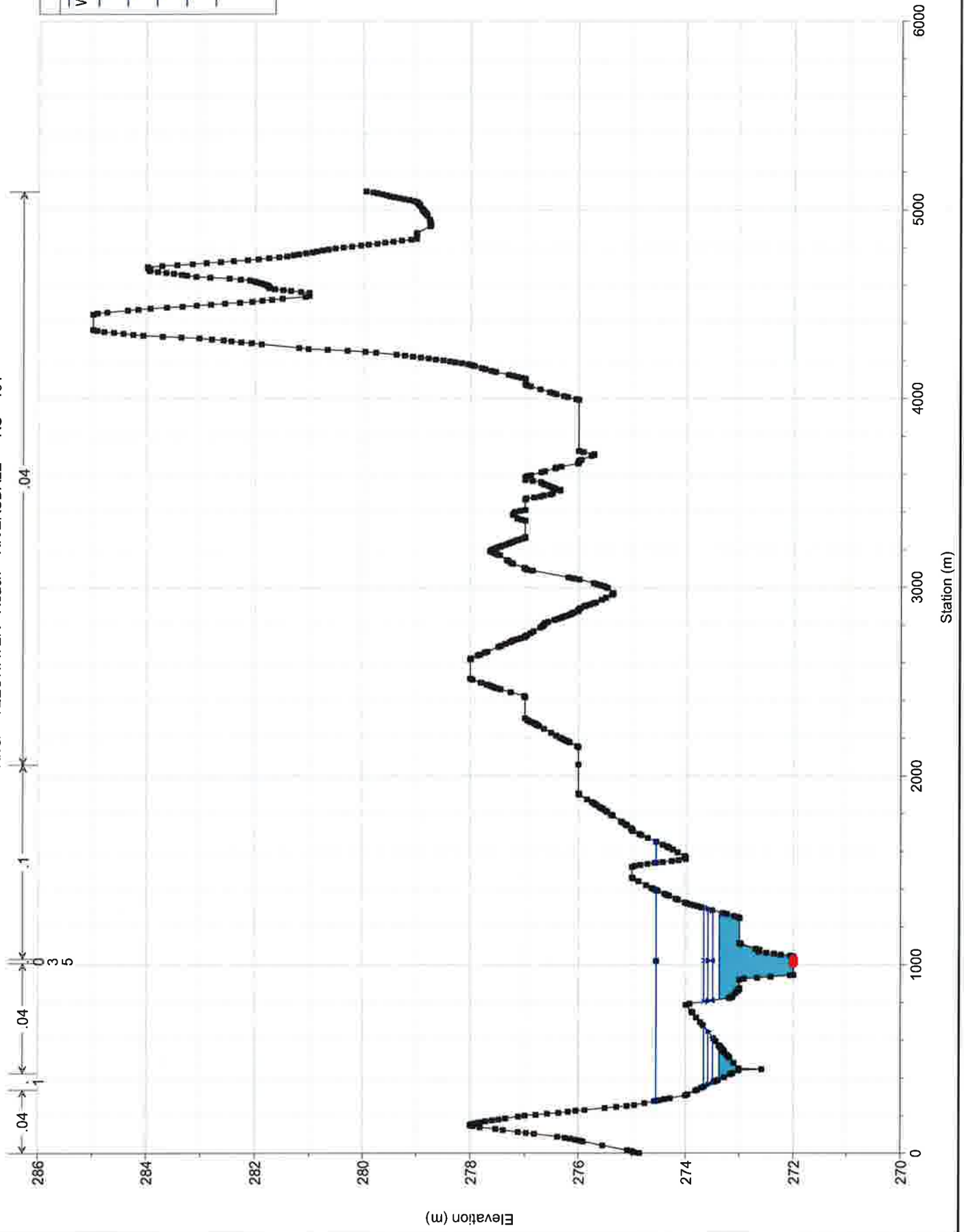
River = TEESWATER Reach = RIVERSDALE RS = 102



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

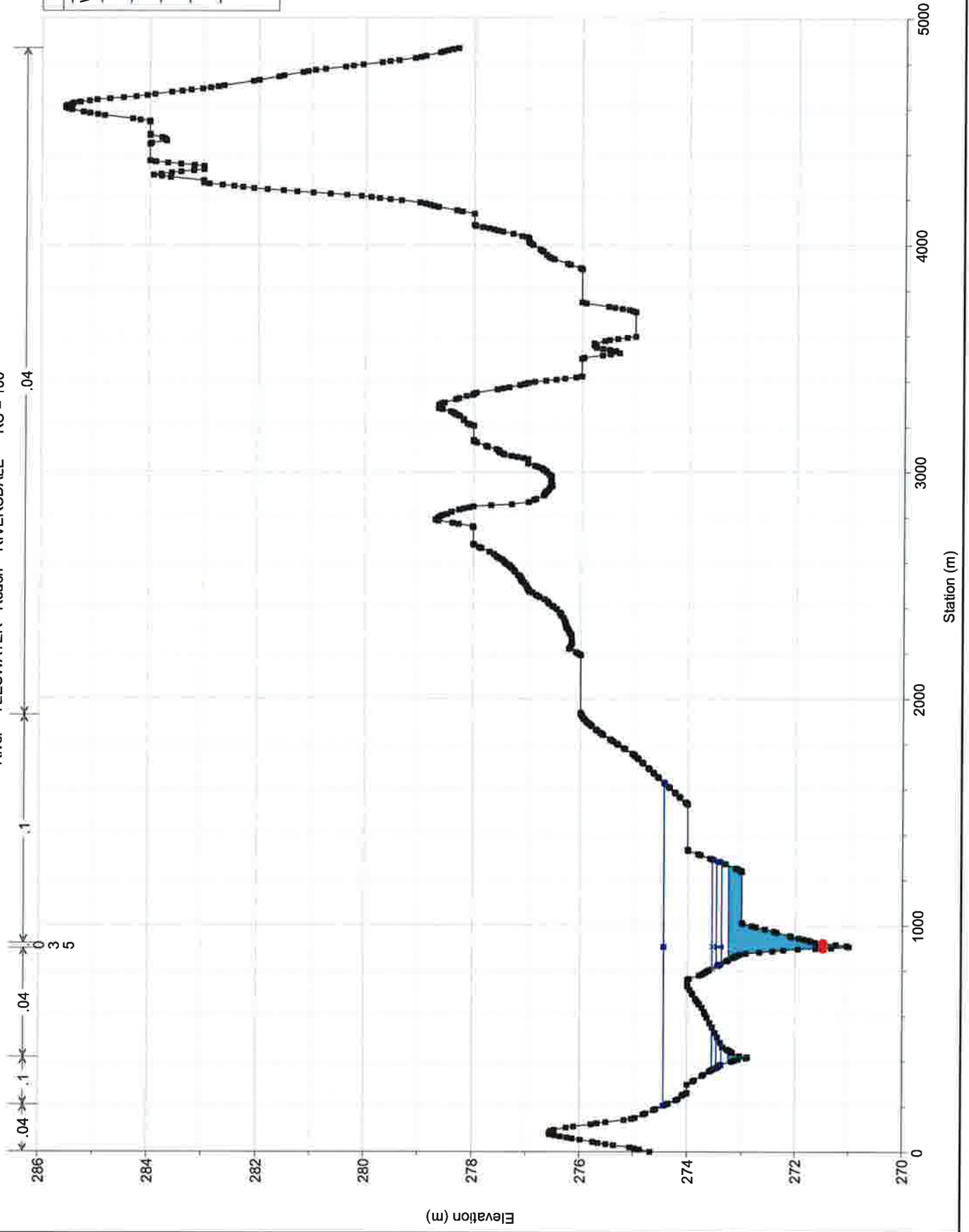
River = TEESWATER Reach = RIVERSDALE RS = 101



RIVERSDALE Plan: PR - OFAT INDEX 1/23/2018

Geom: PROPOSED Flow: OFAT INDEX FLOOD (10-100 YR)

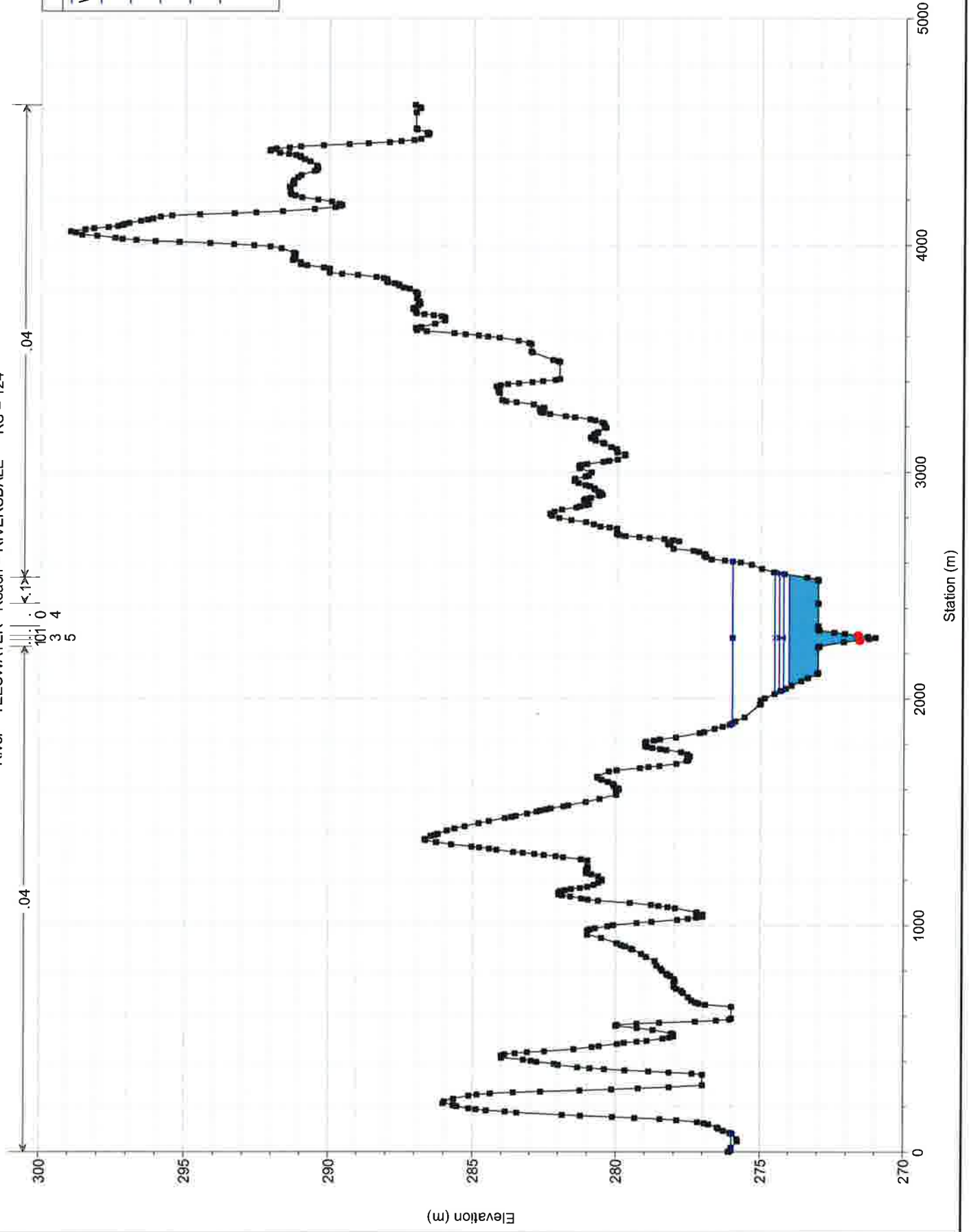
River = TEESWATER Reach = RIVERSDALE RS = 100



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

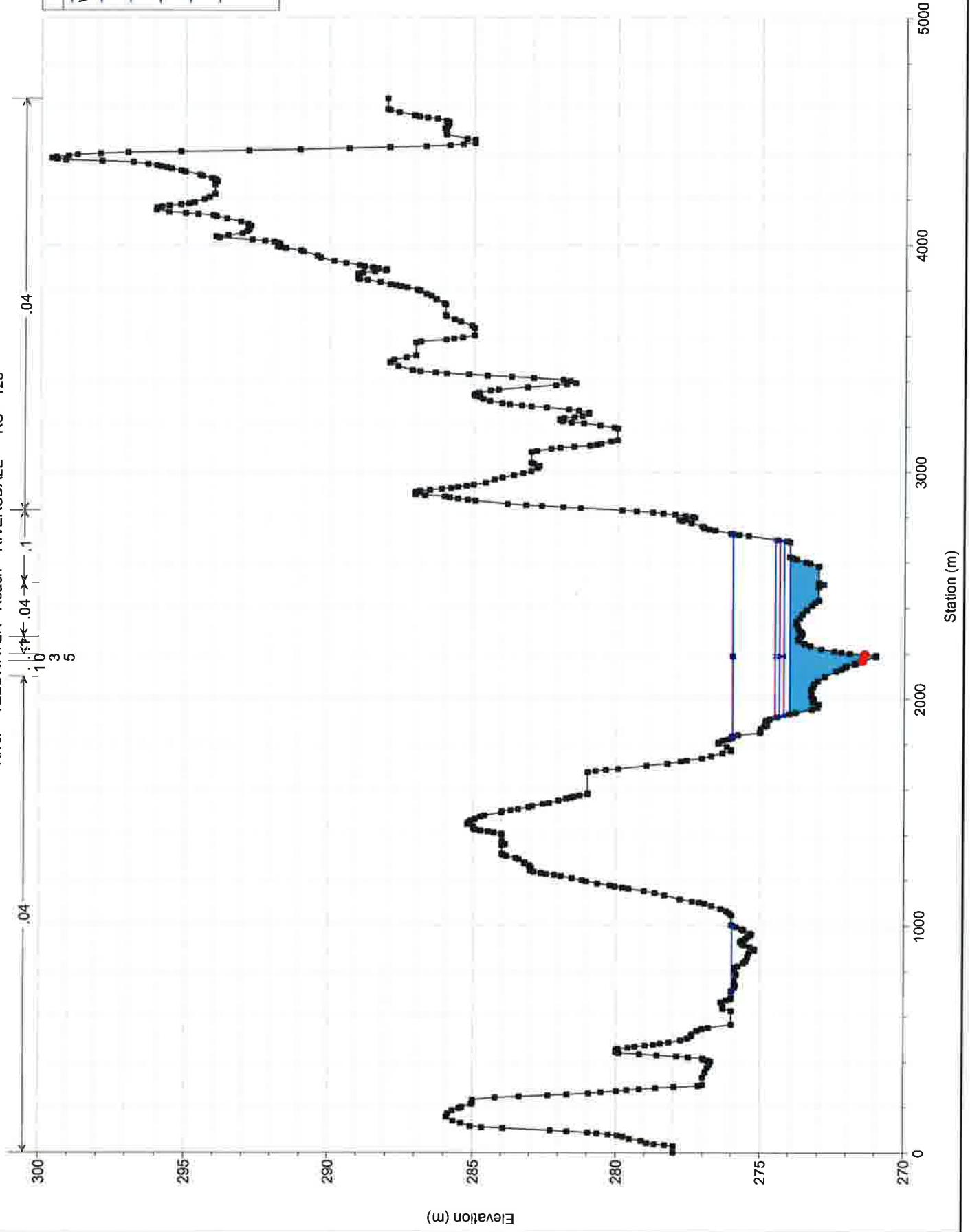
River = TEESWATER Reach = RIVERSDALE RS = 124



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

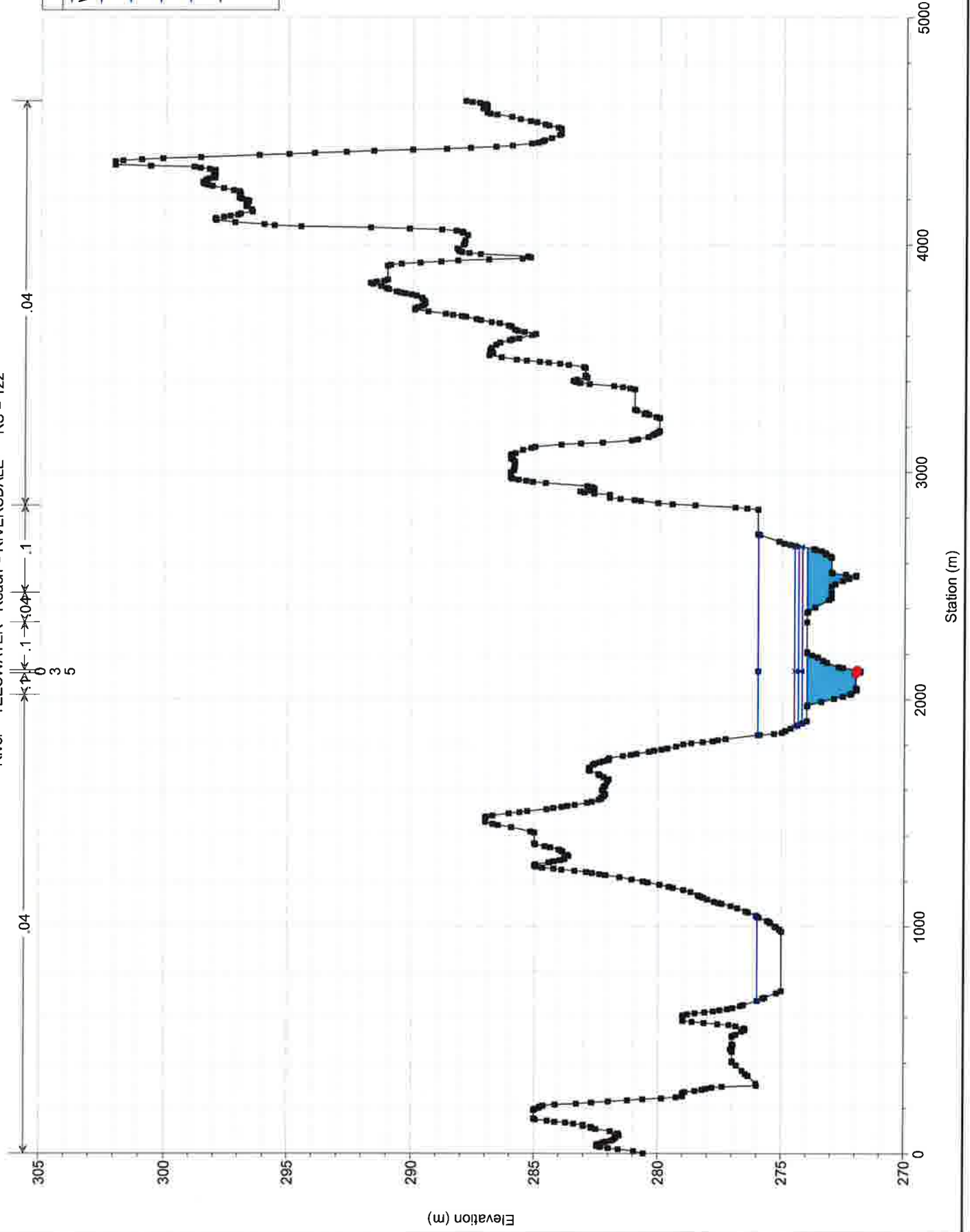
River = TEESWATER Reach = RIVERSDALE RS = 123



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

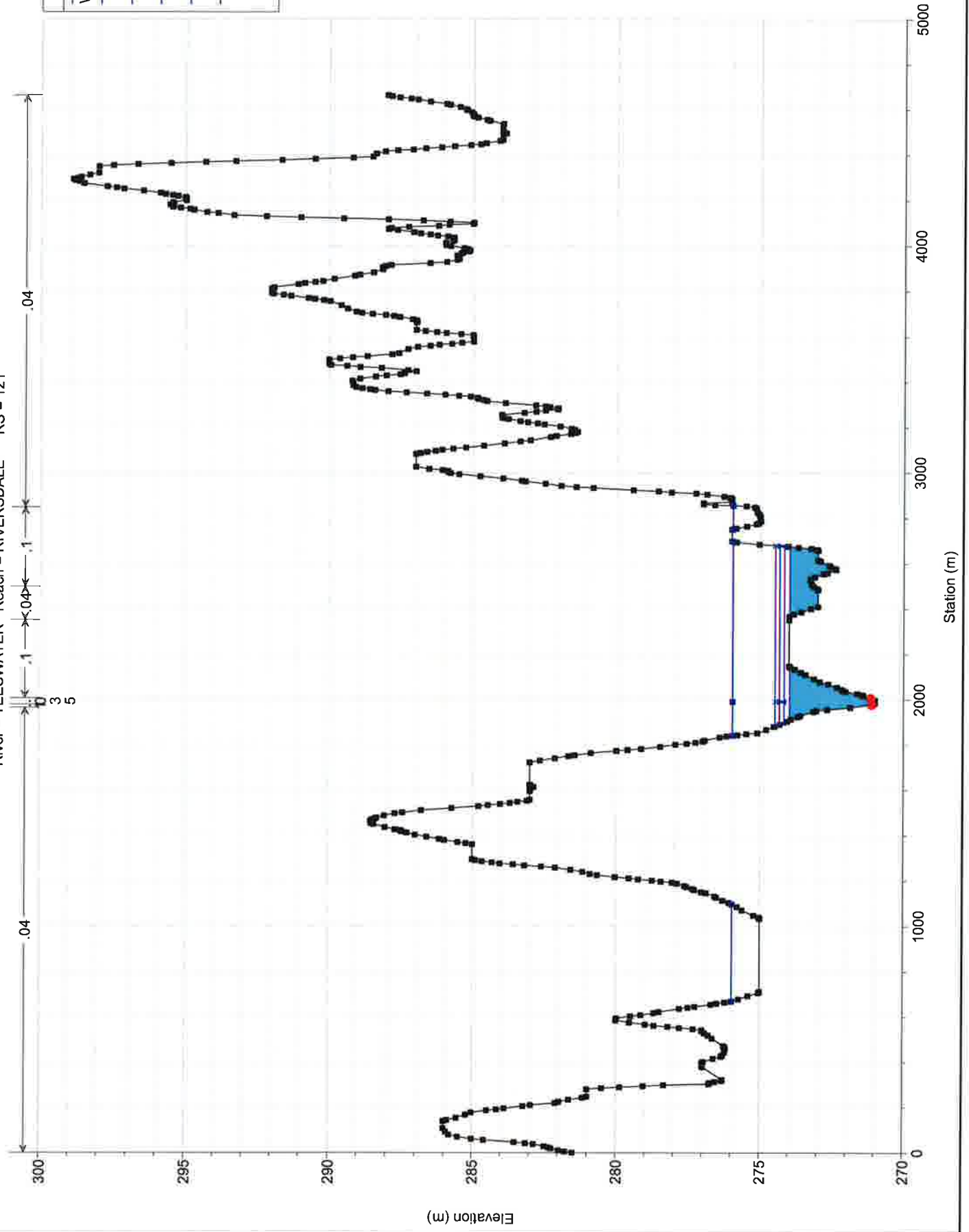
River = TEESWATER Reach = RIVERSDALE RS = 122



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

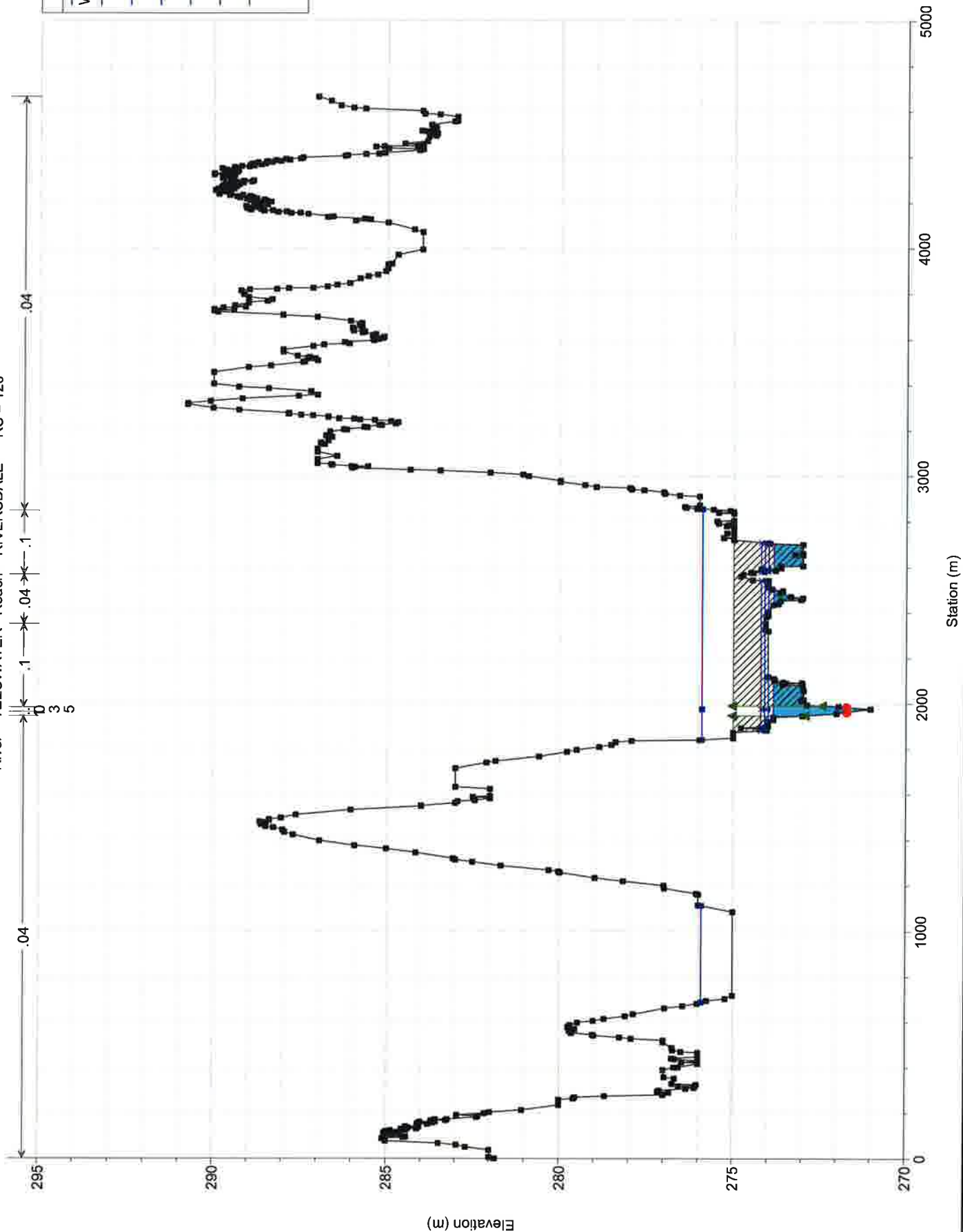
River = TEESWATER Reach = RIVERSDALE RS = 121



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

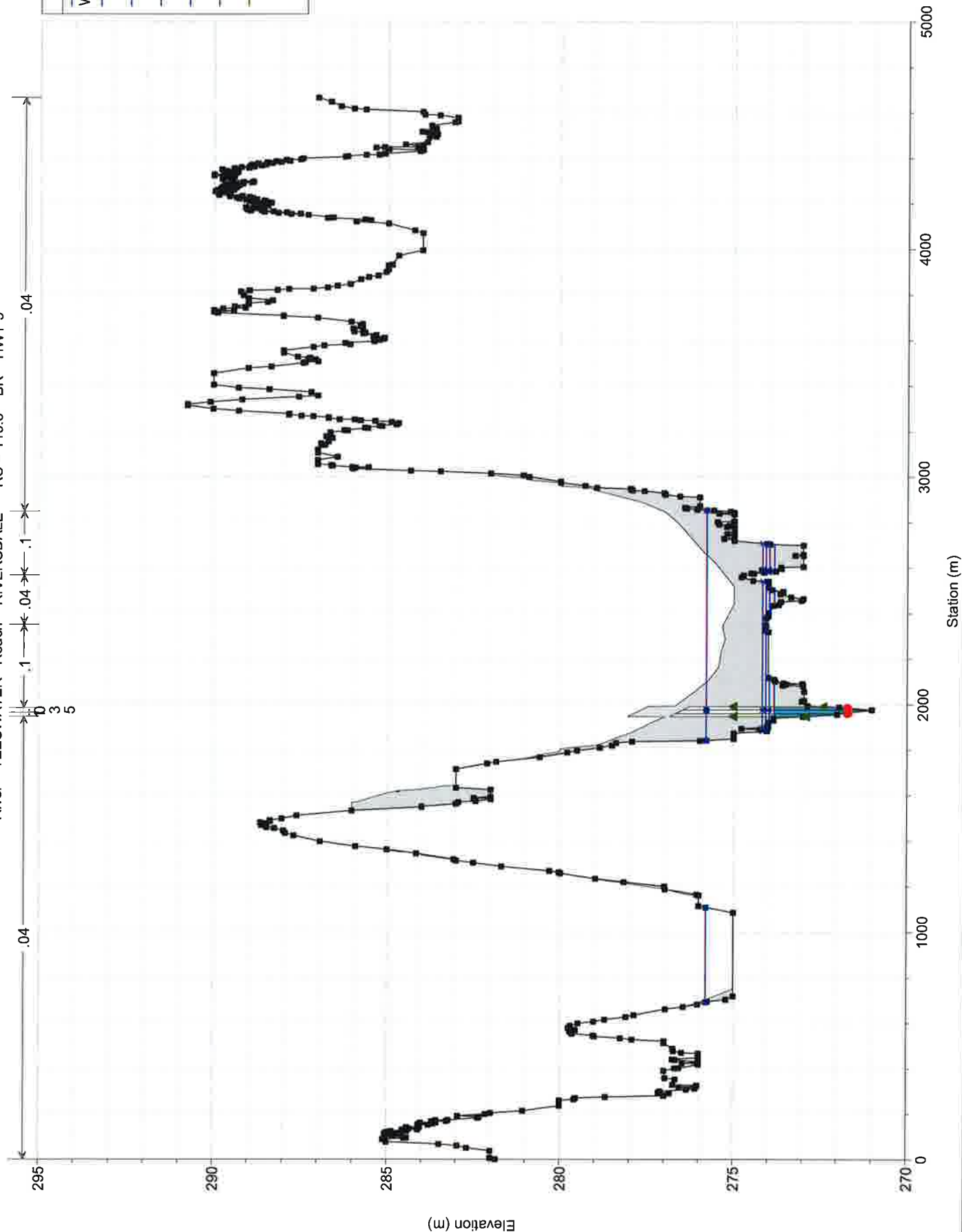
River = TEESWATER Reach = RIVERSDALE RS = 120



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

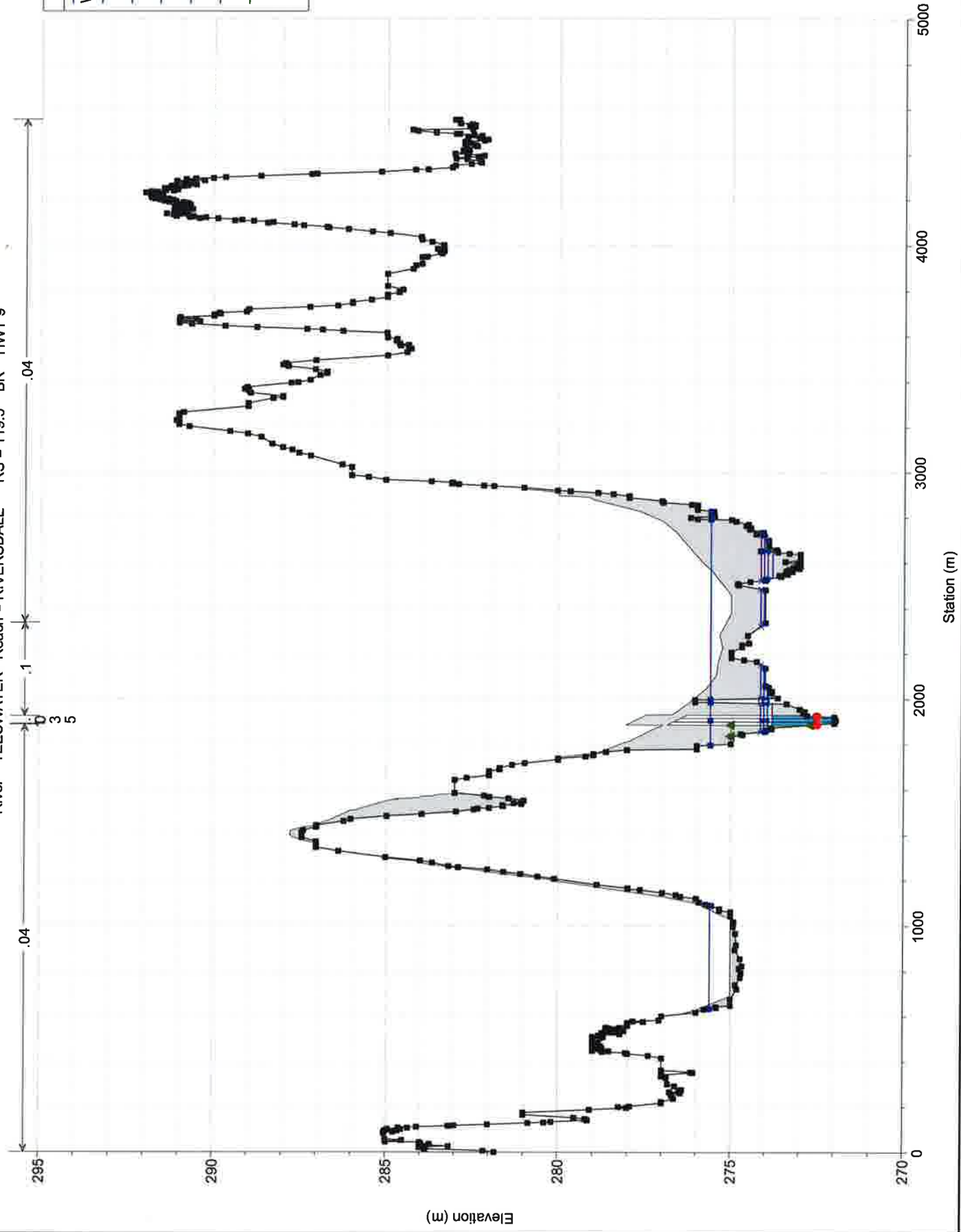
River = TEESWATER Reach = RIVERSDALE RS = 119.5 BR HWY 9



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

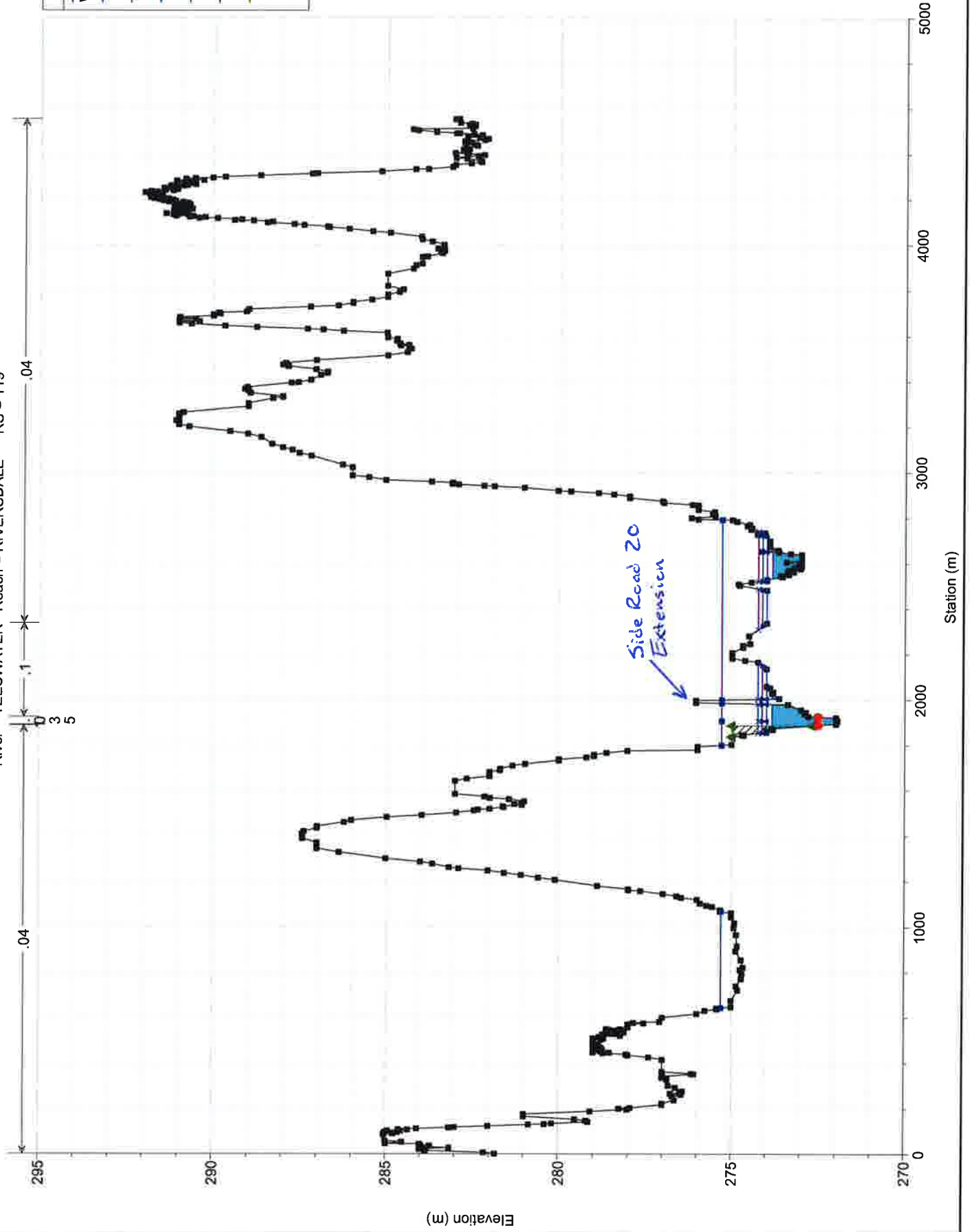
River = TEESWATER Reach = RIVERSDALE RS = 119.5 BR HWY 9



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 119

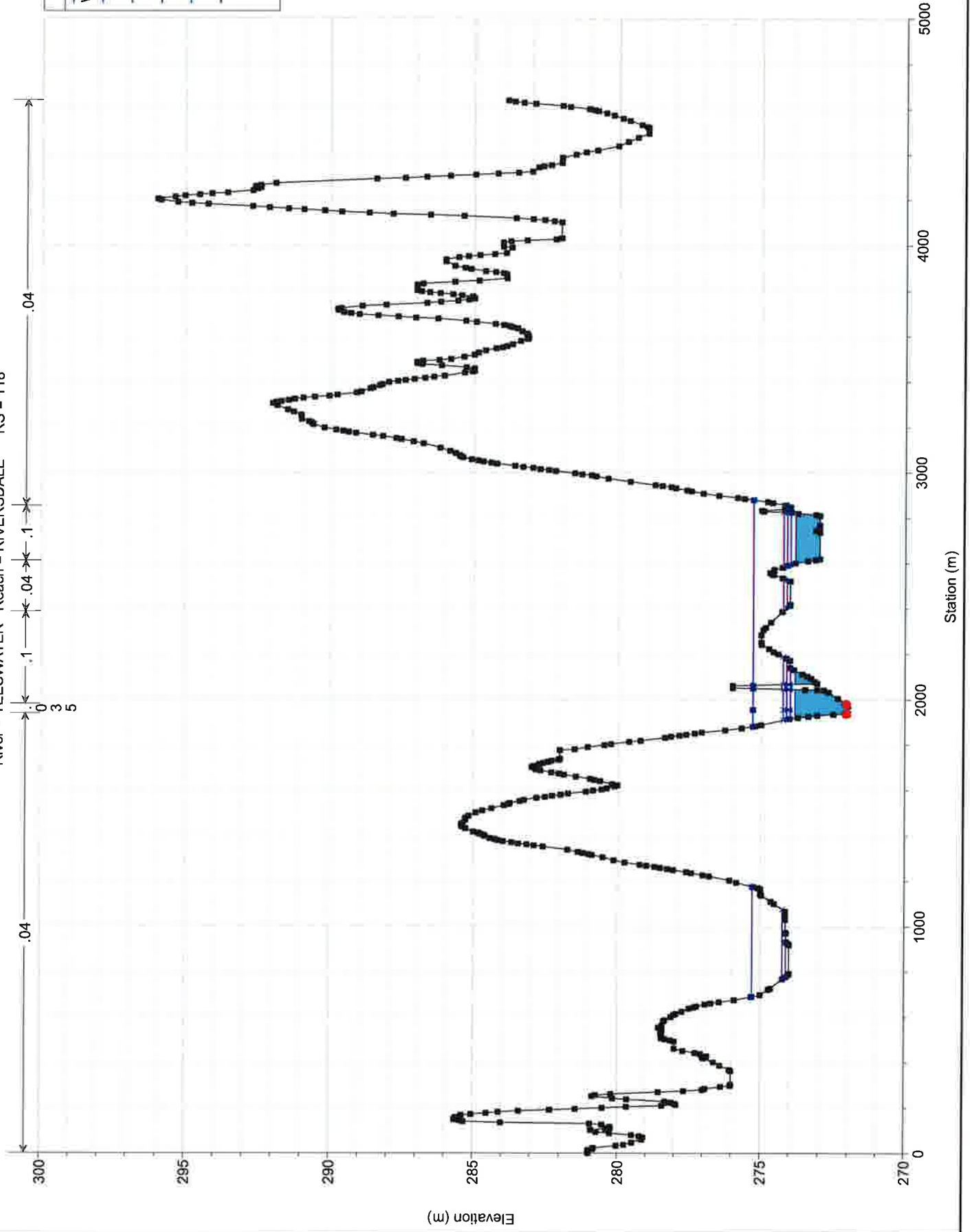


| Legend | |
|-------------|-----------|
| WS REGIONAL | WS 100-YR |
| WS 50-YR | WS 25-YR |
| WS 10-YR | Ground |
| Ineff | Bank Sta |

RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

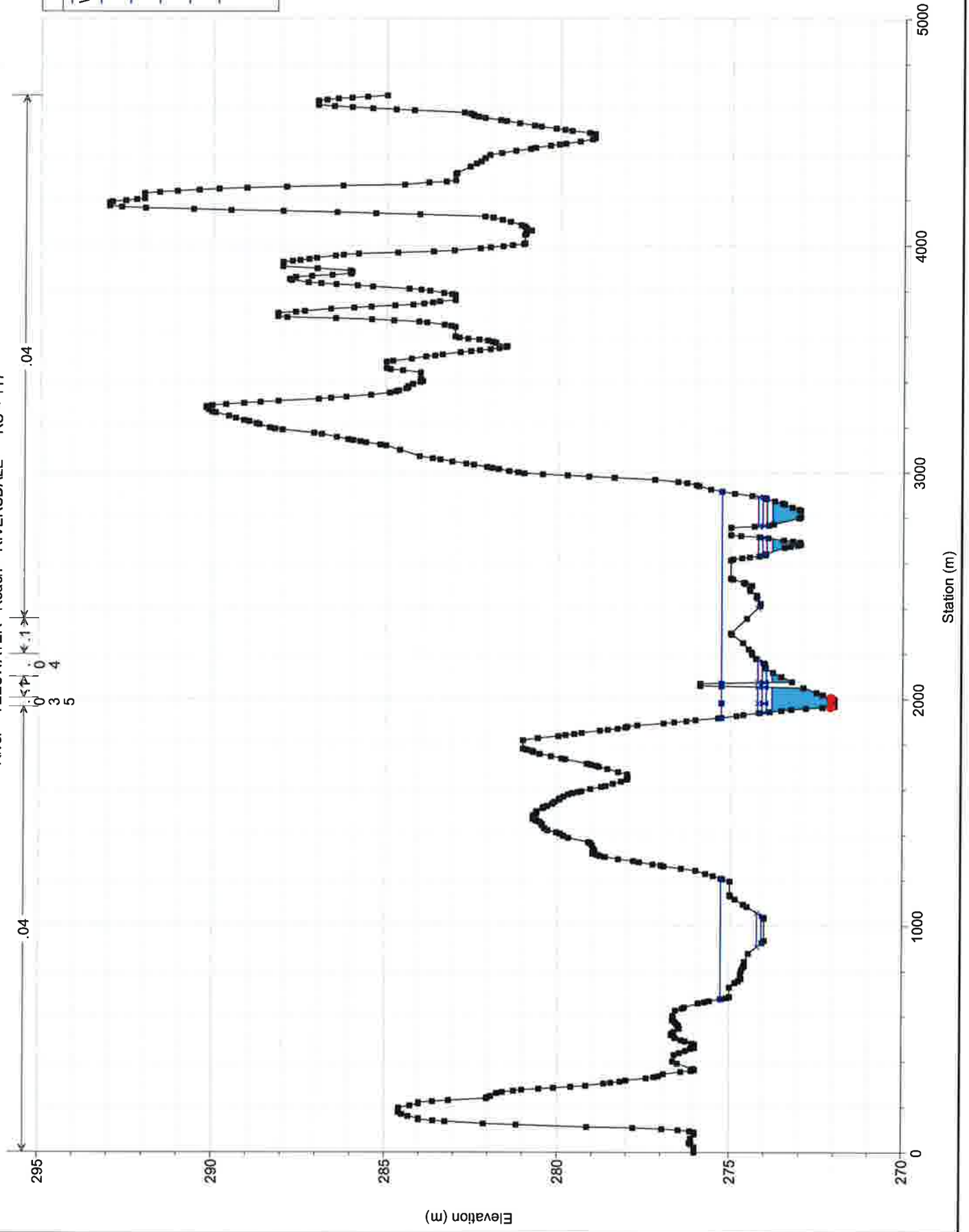
River = TEESWATER Reach = RIVERSDALE RS = 118



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

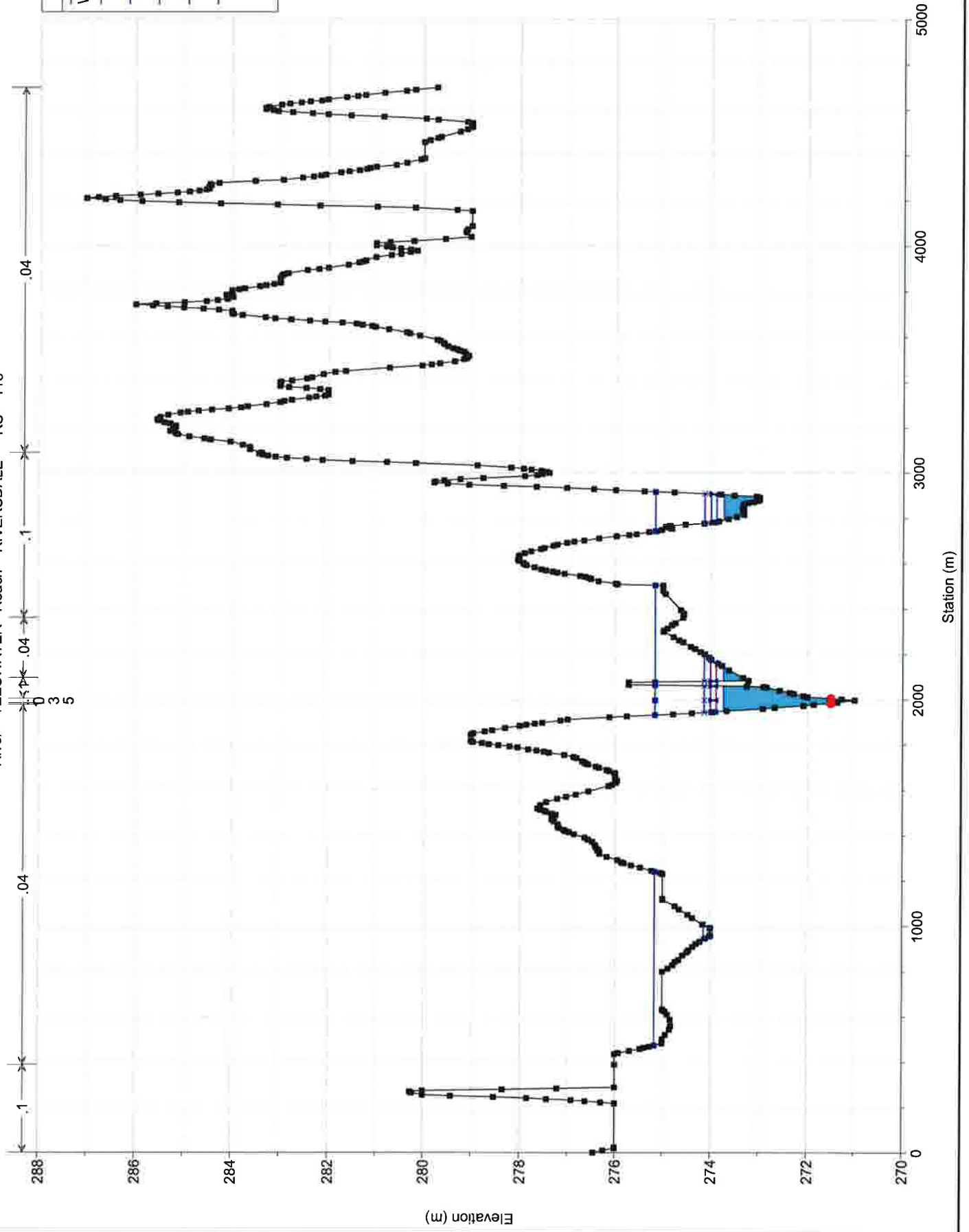
River = TEESWATER Reach = RIVERSDALE RS = 117



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

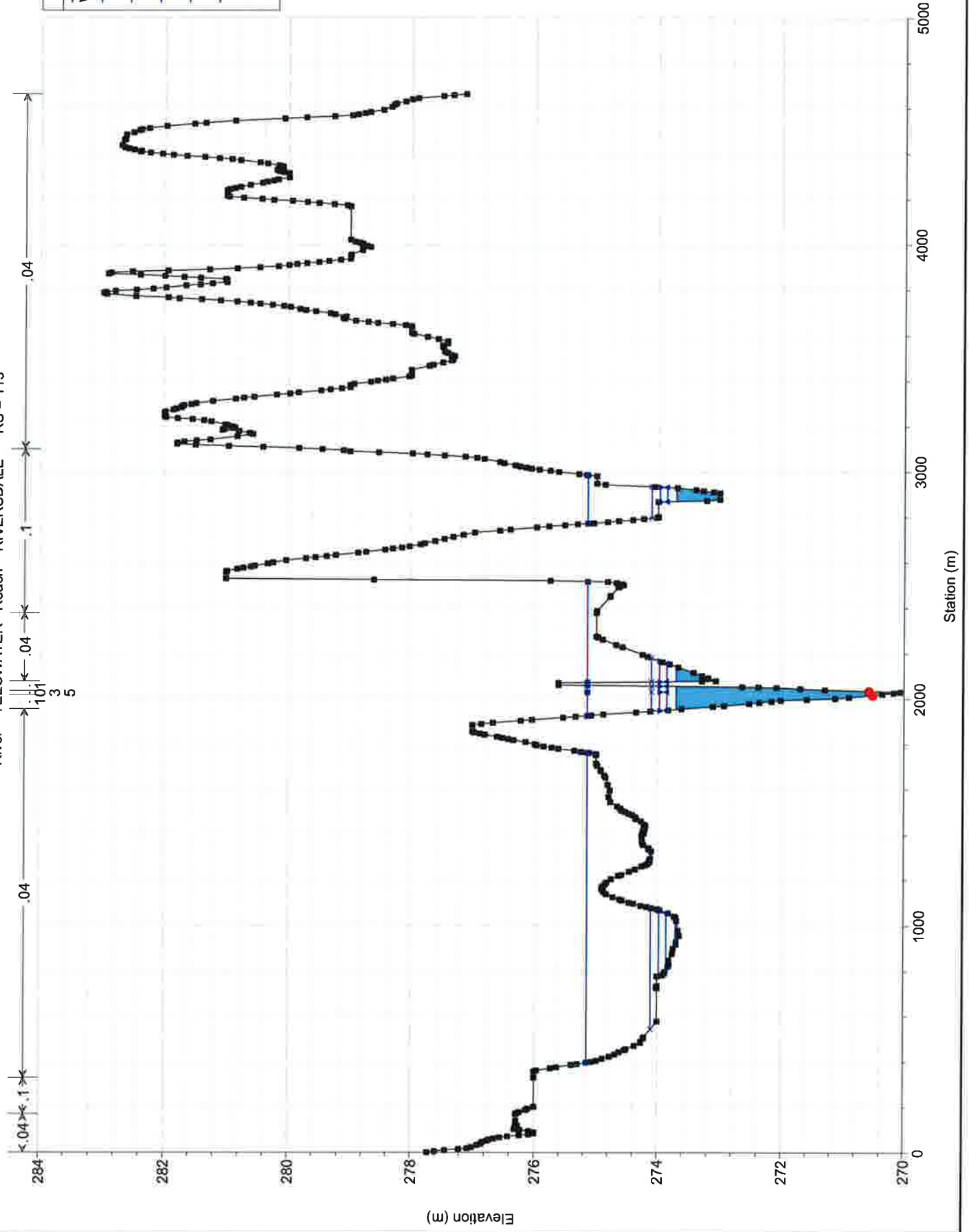
River = TEESWATER Reach = RIVERSDALE RS = 116



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

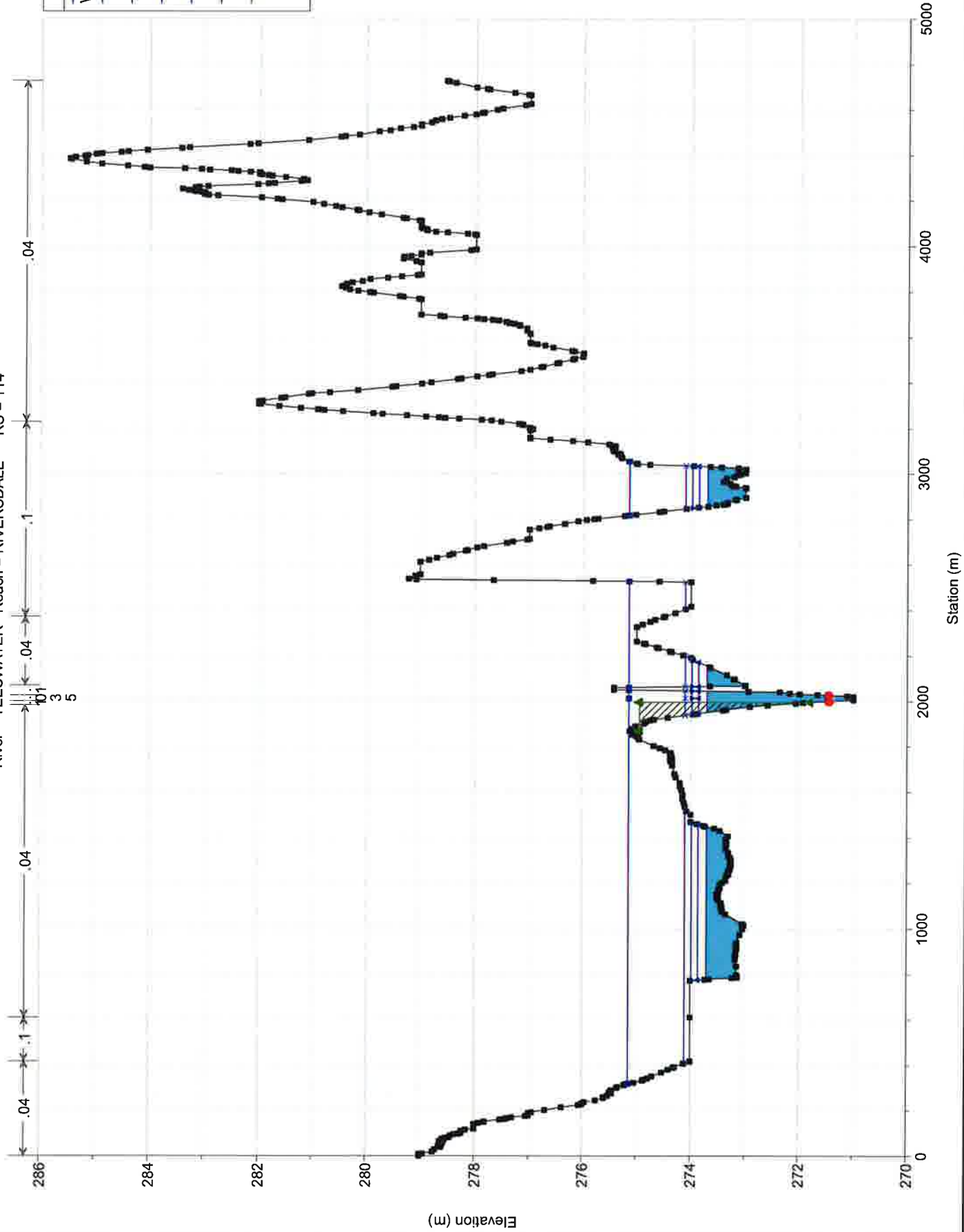
River = TEESWATER Reach = RIVERSDALE RS = 115



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

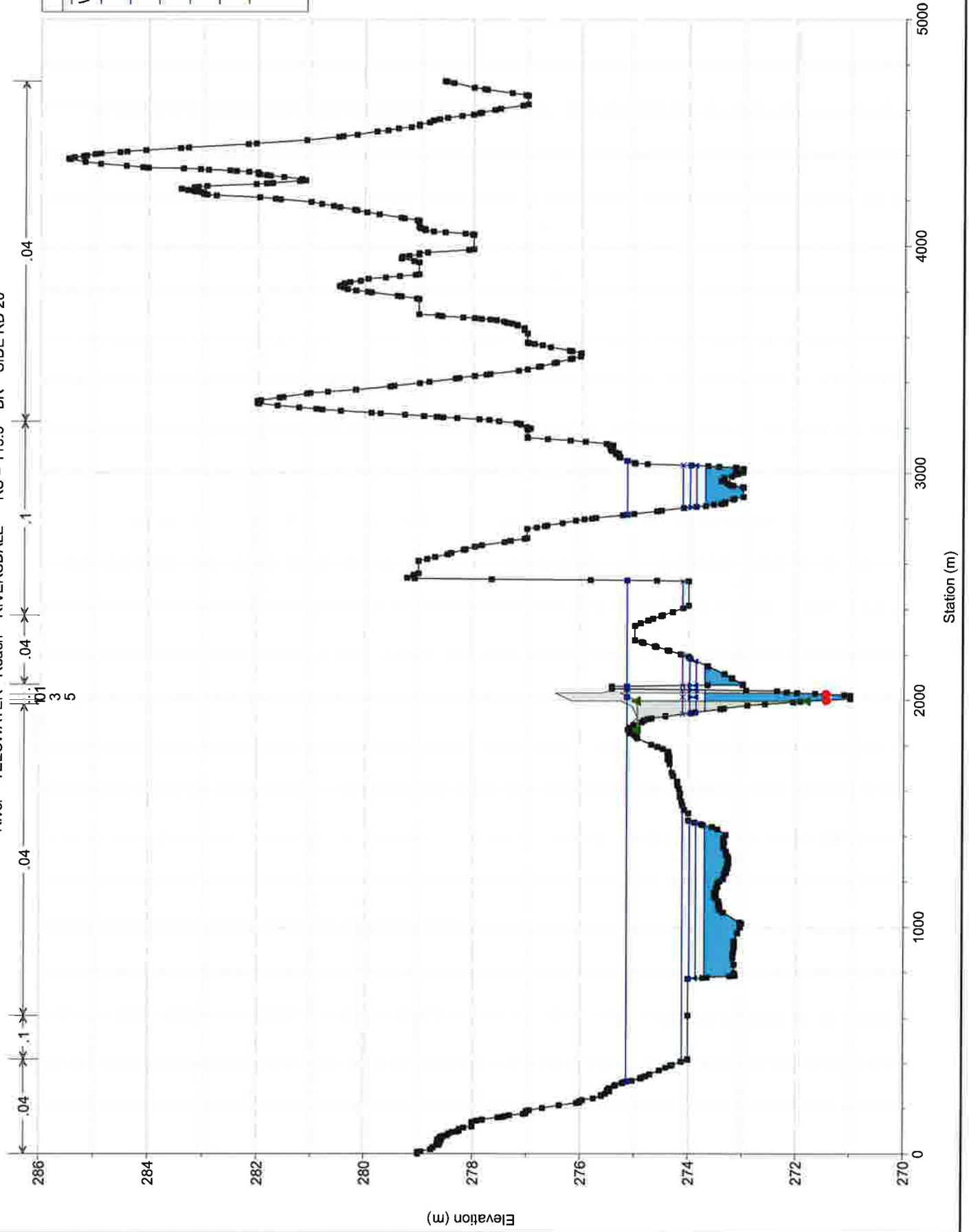
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 114



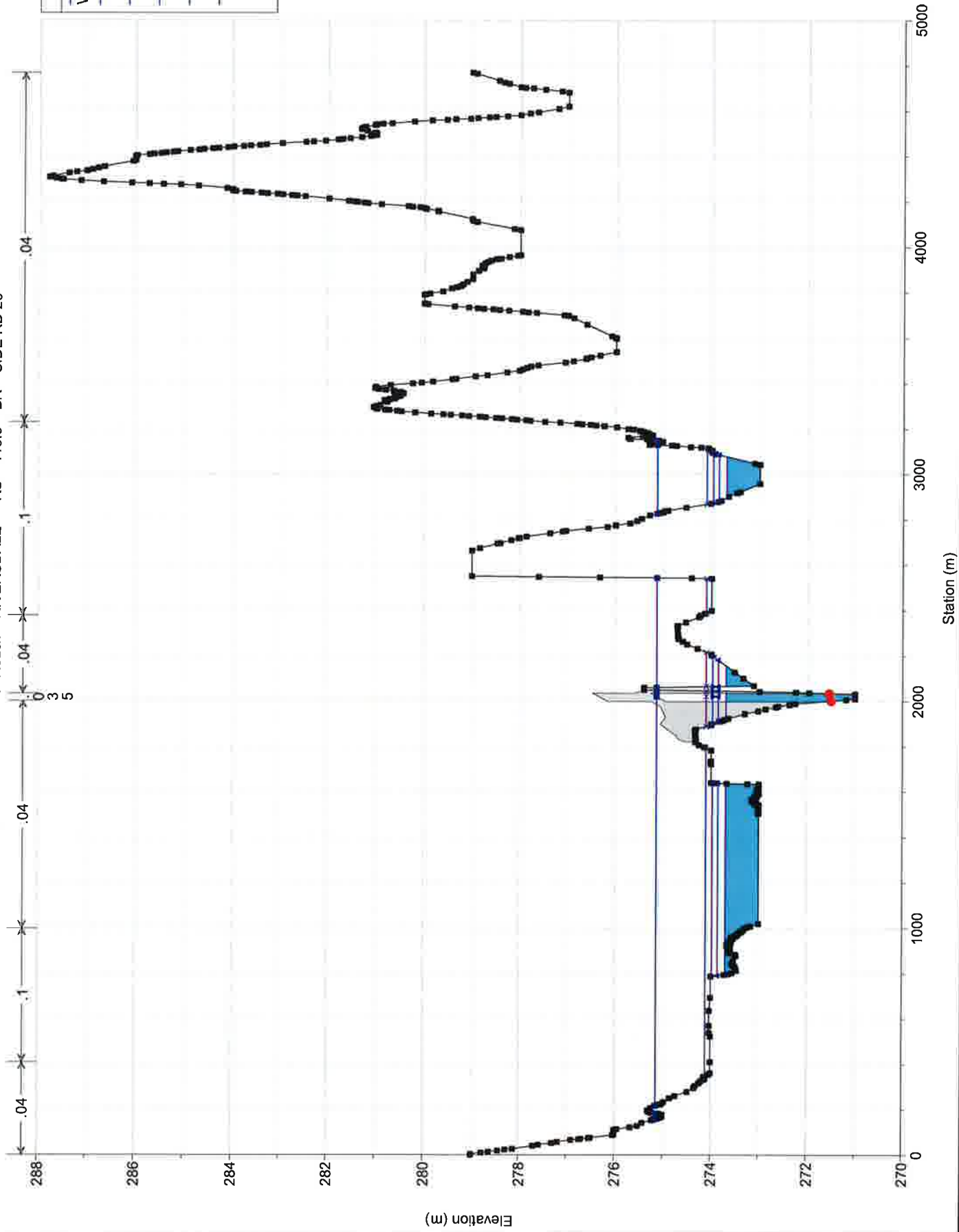
RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 113.5 BR SIDE RD 20



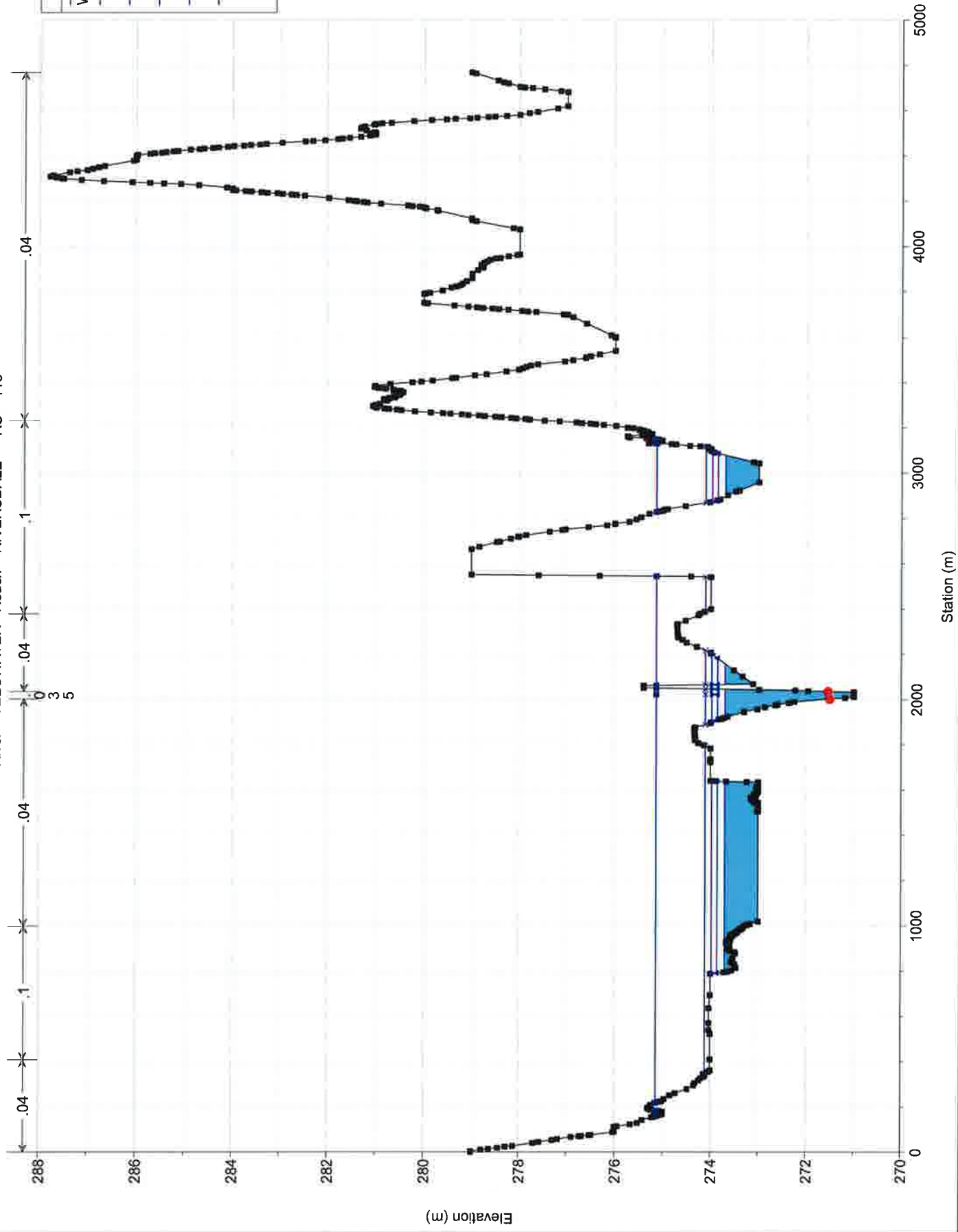
RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 113.5 BR SIDE RD 20



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

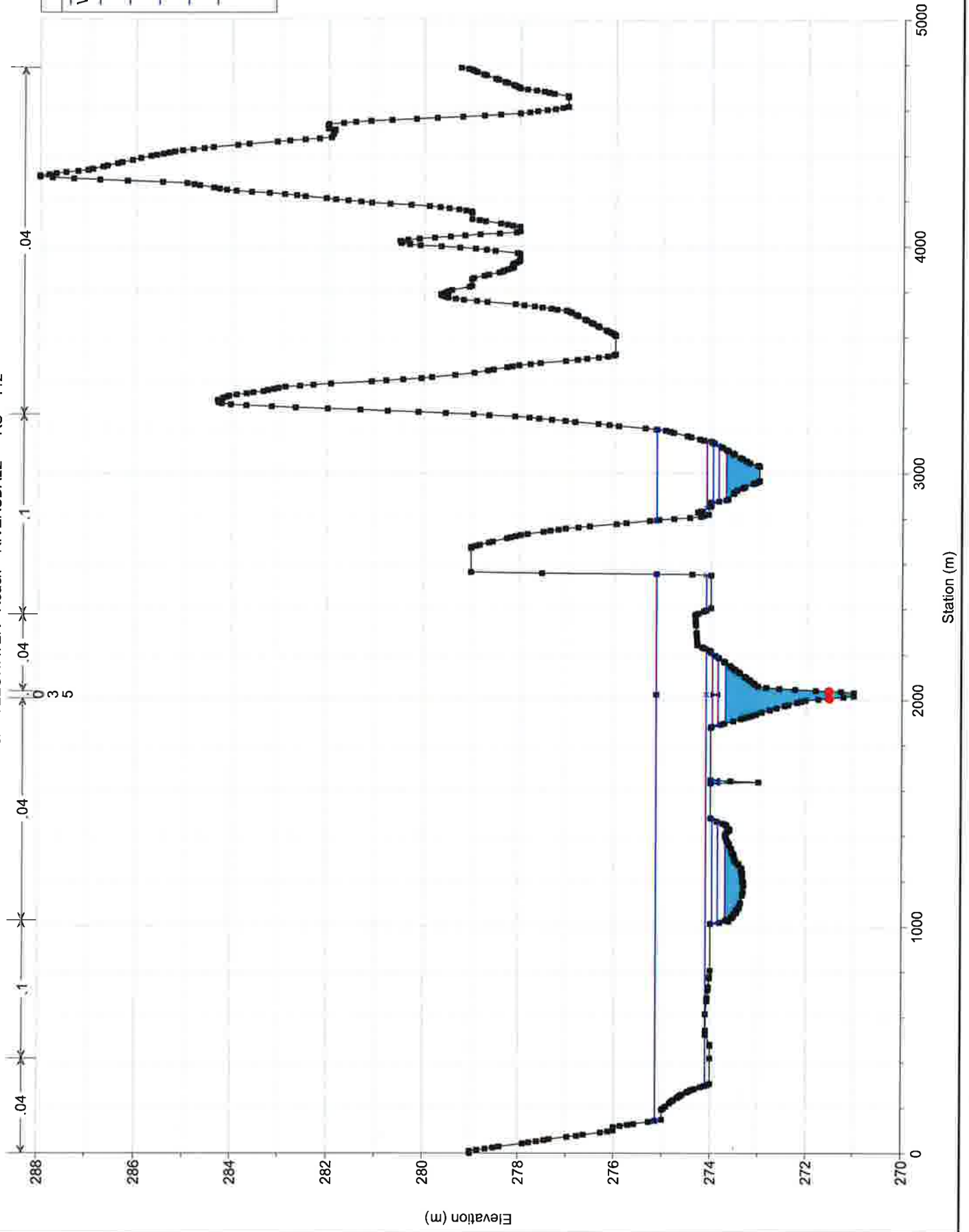
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 113



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

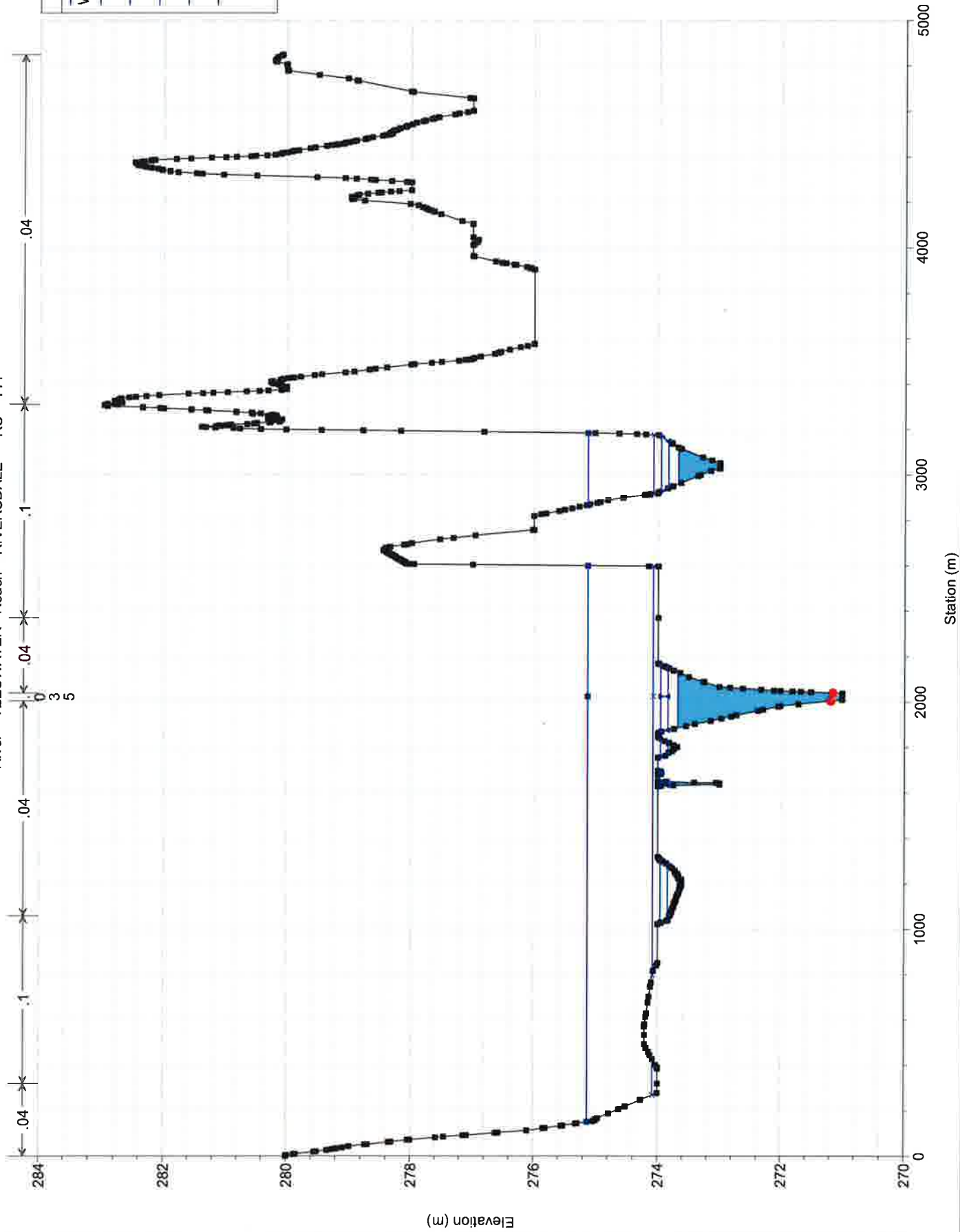
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 112



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

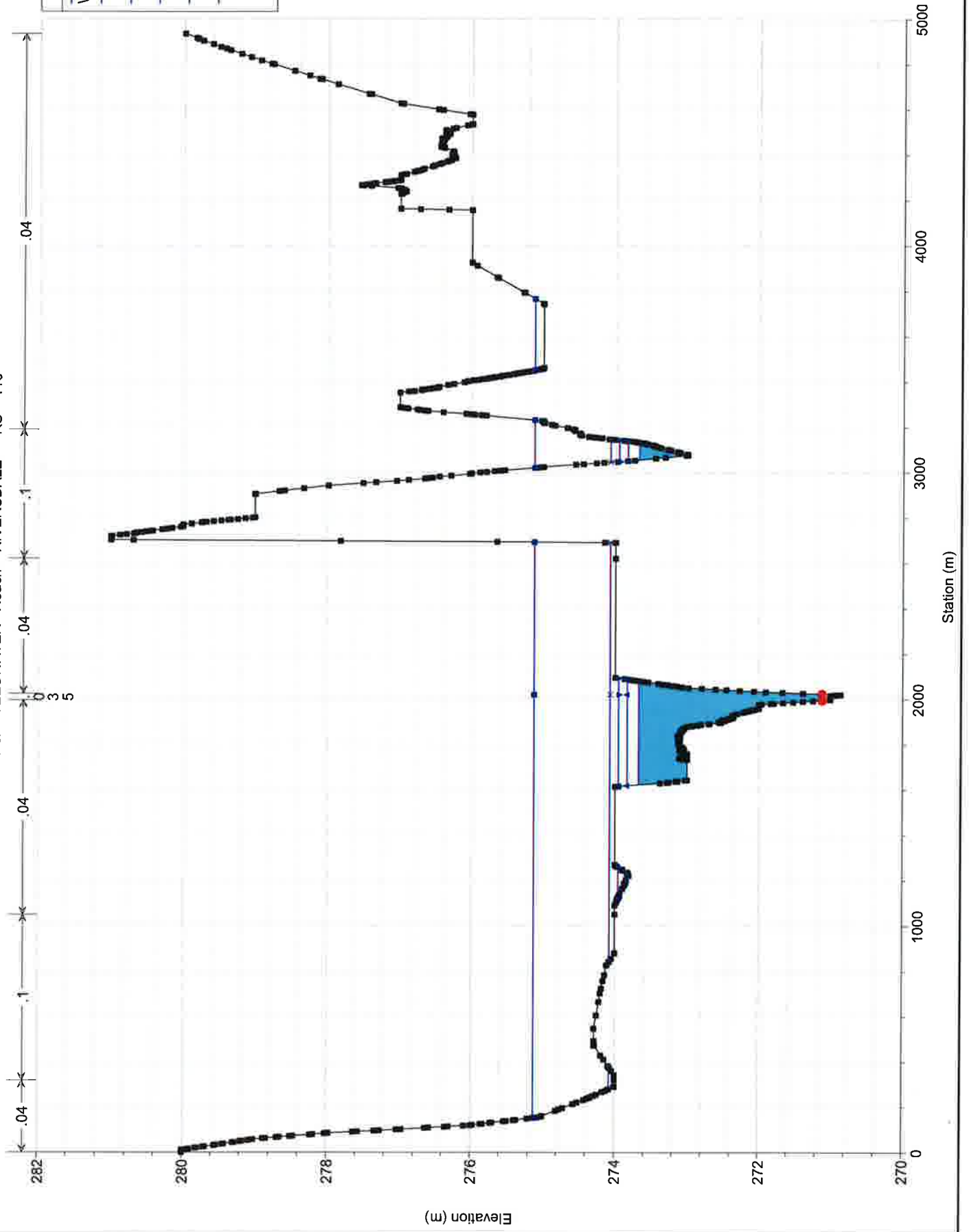
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 111



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

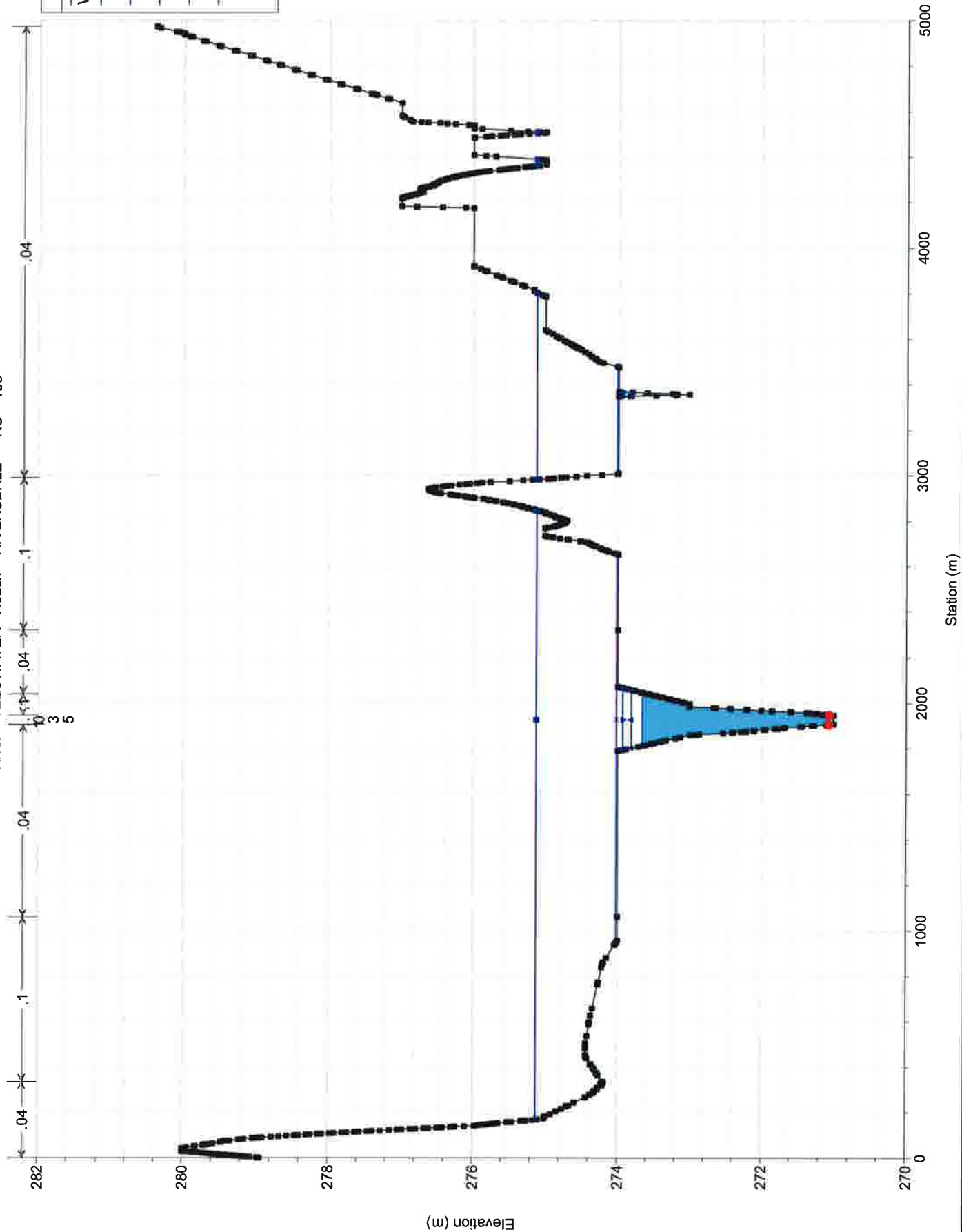
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 110



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

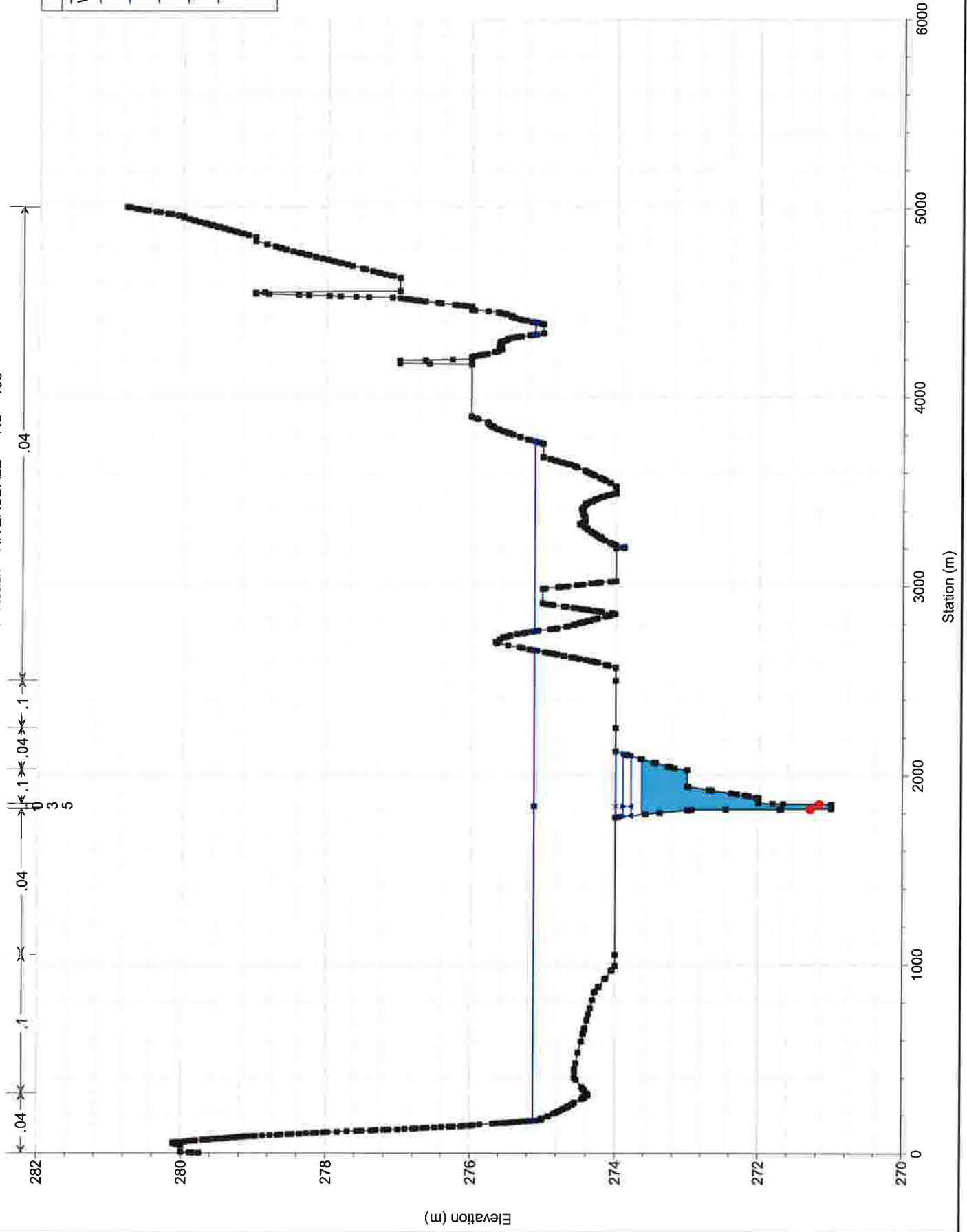
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 109



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

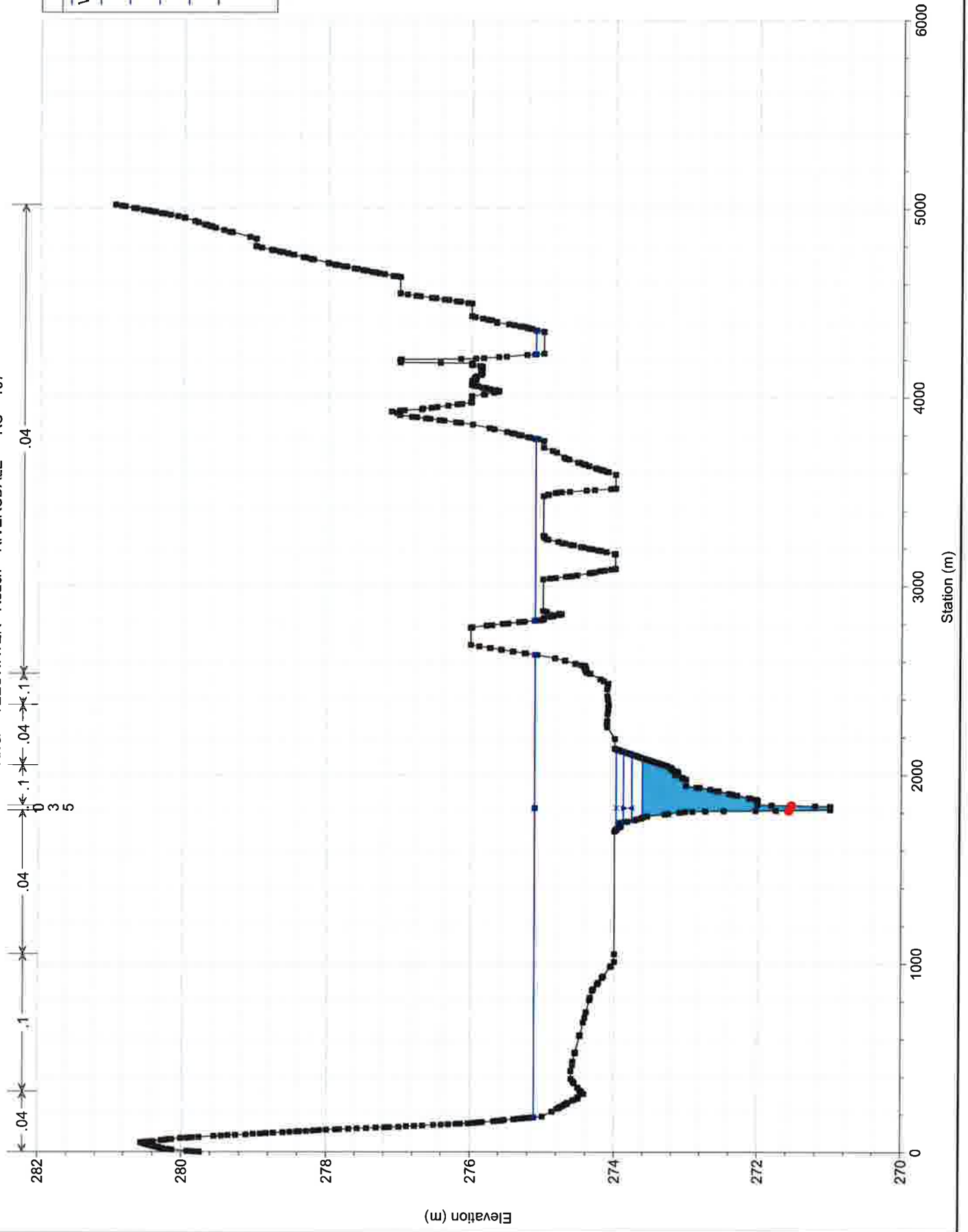
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 108



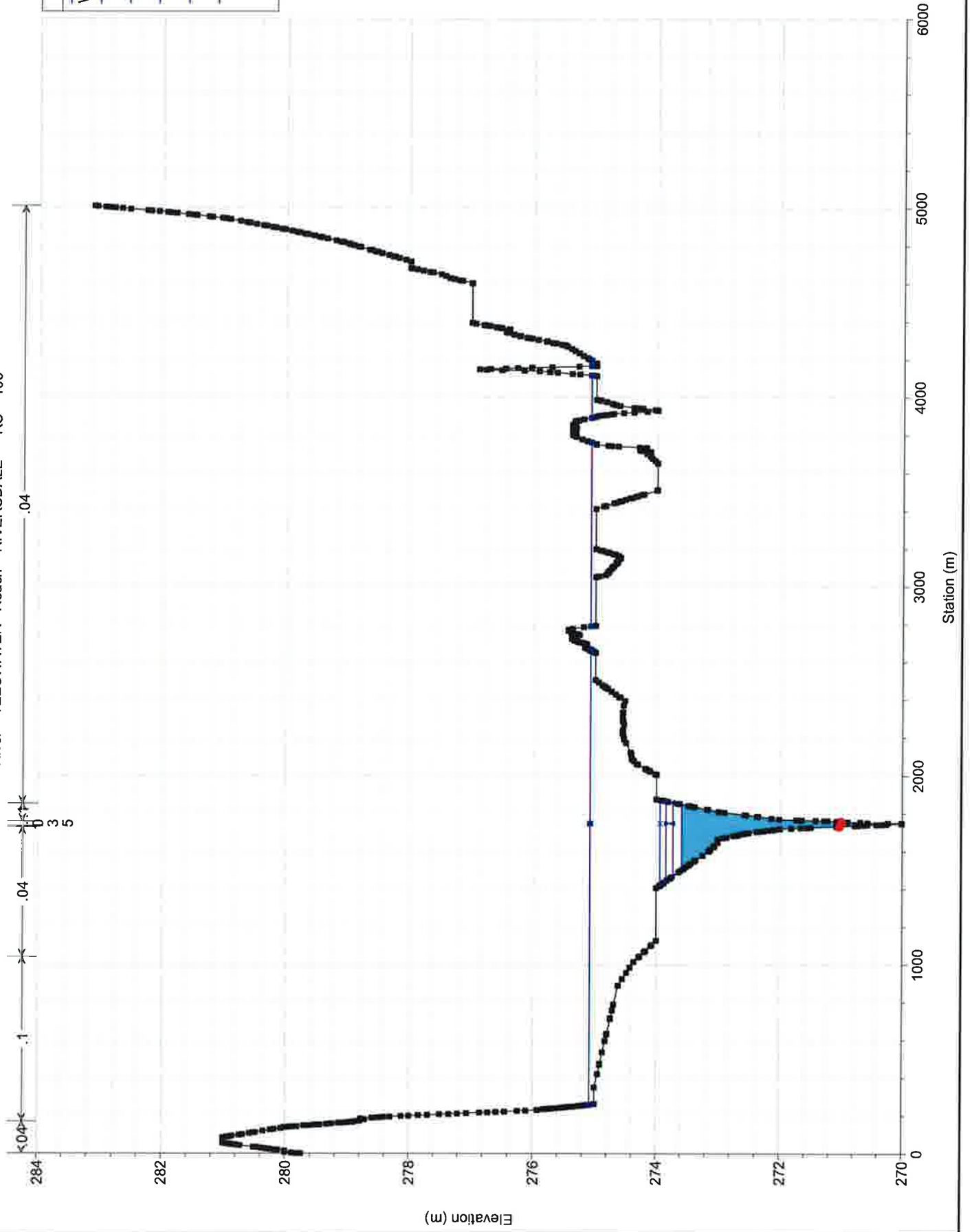
RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 107



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

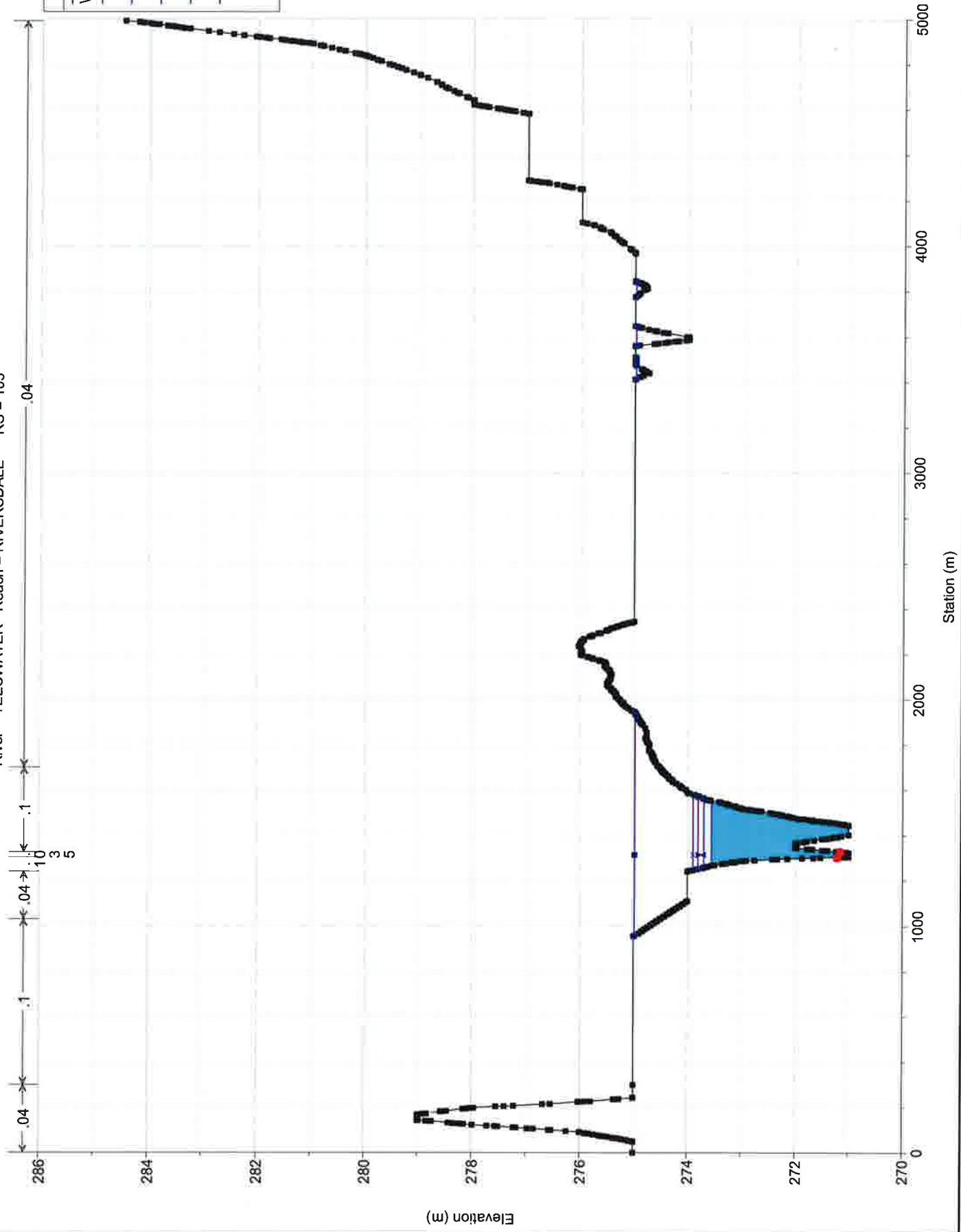
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 106



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

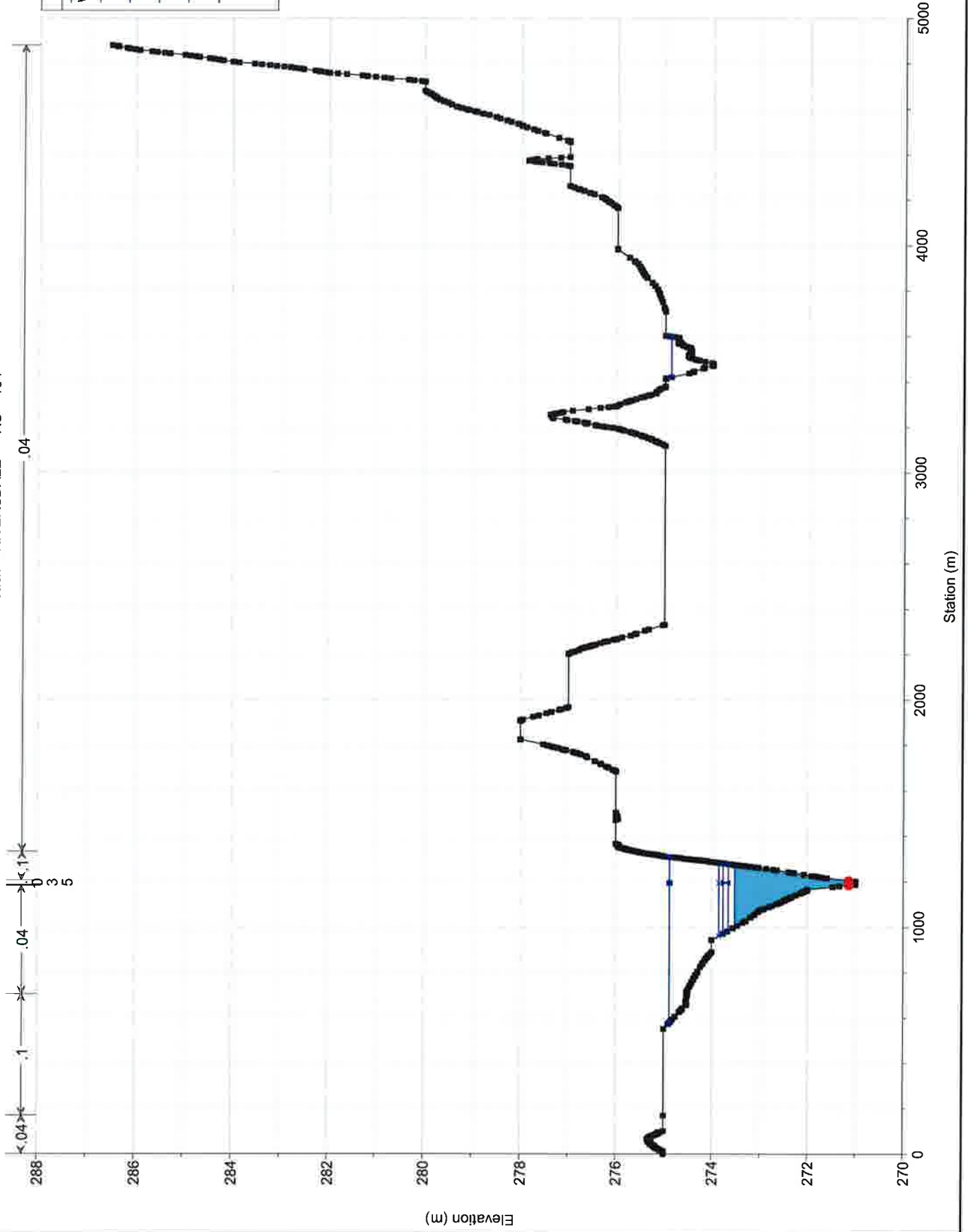
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 105



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

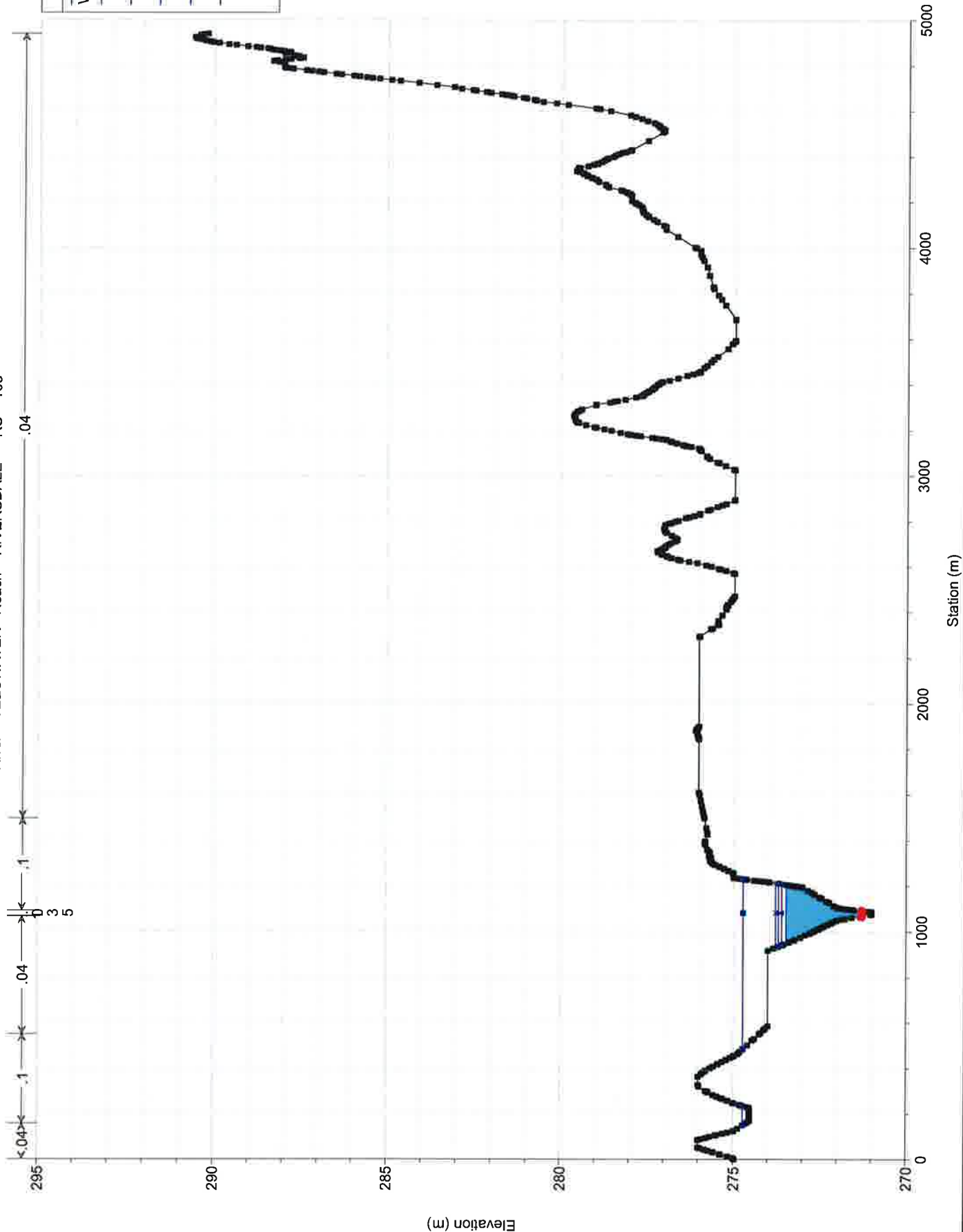
Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
River = TEESWATER Reach = RIVERSDALE RS = 104



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

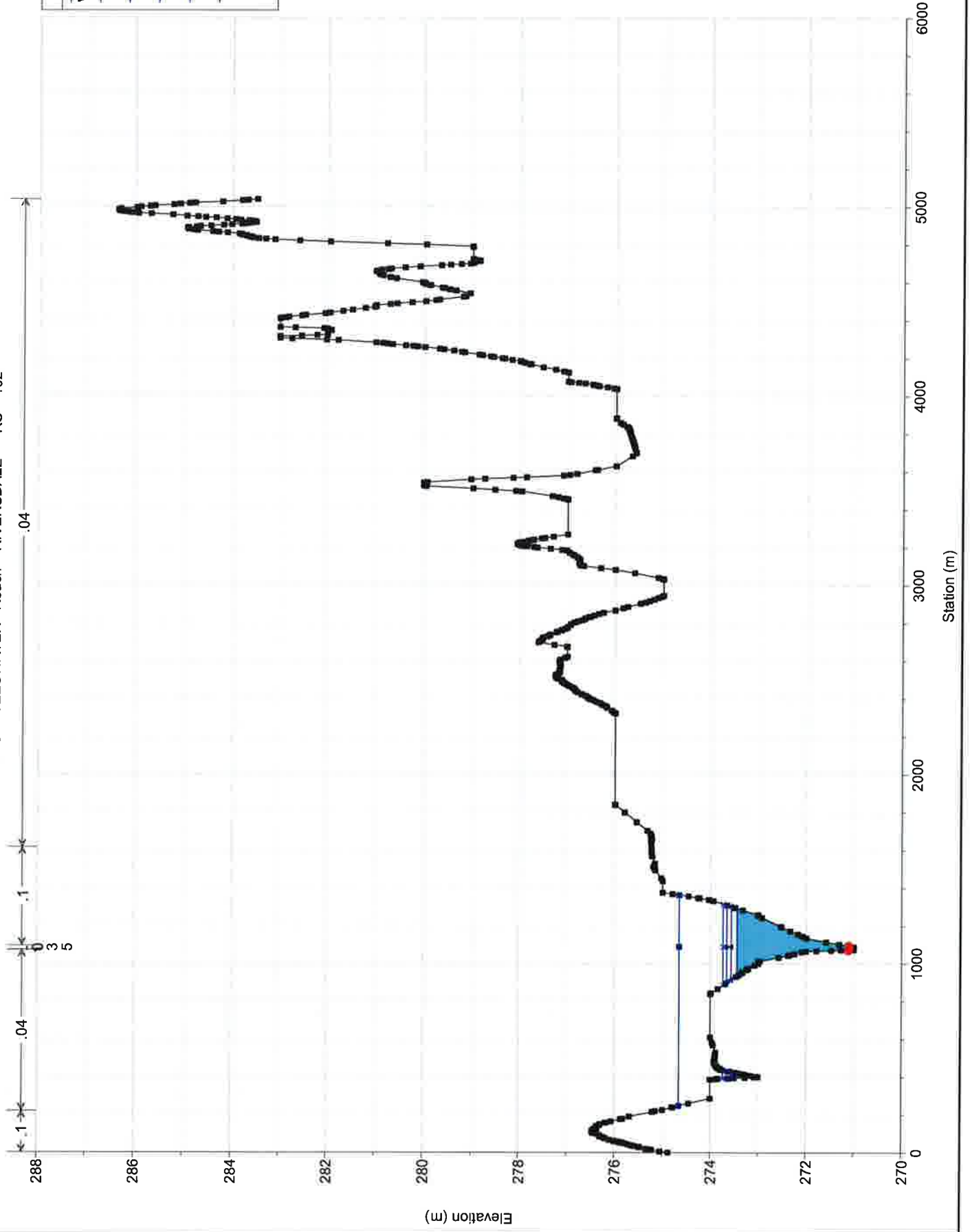
River = TEESWATER Reach = RIVERSDALE RS = 103



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

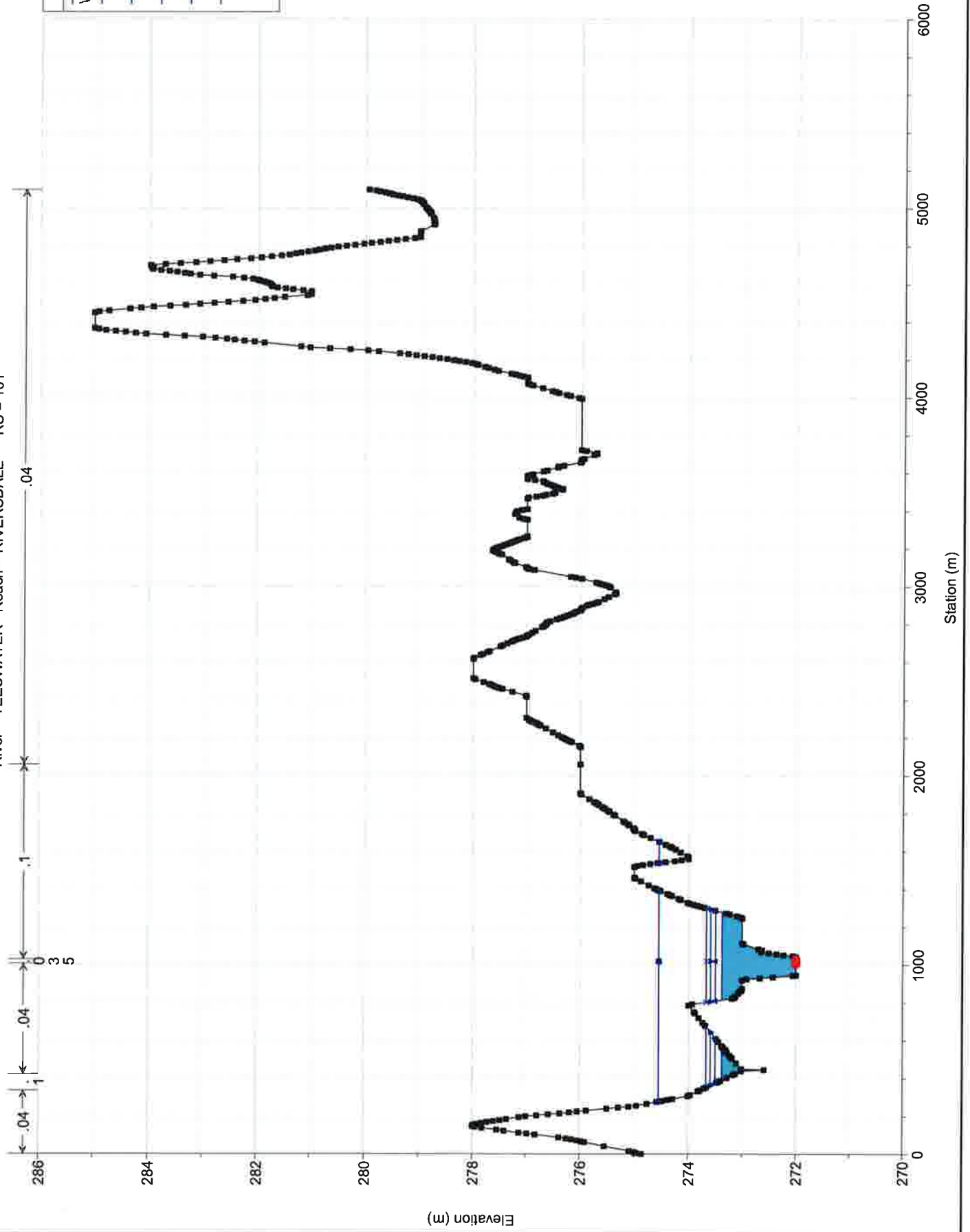
River = TEESWATER Reach = RIVERSDALE RS = 102



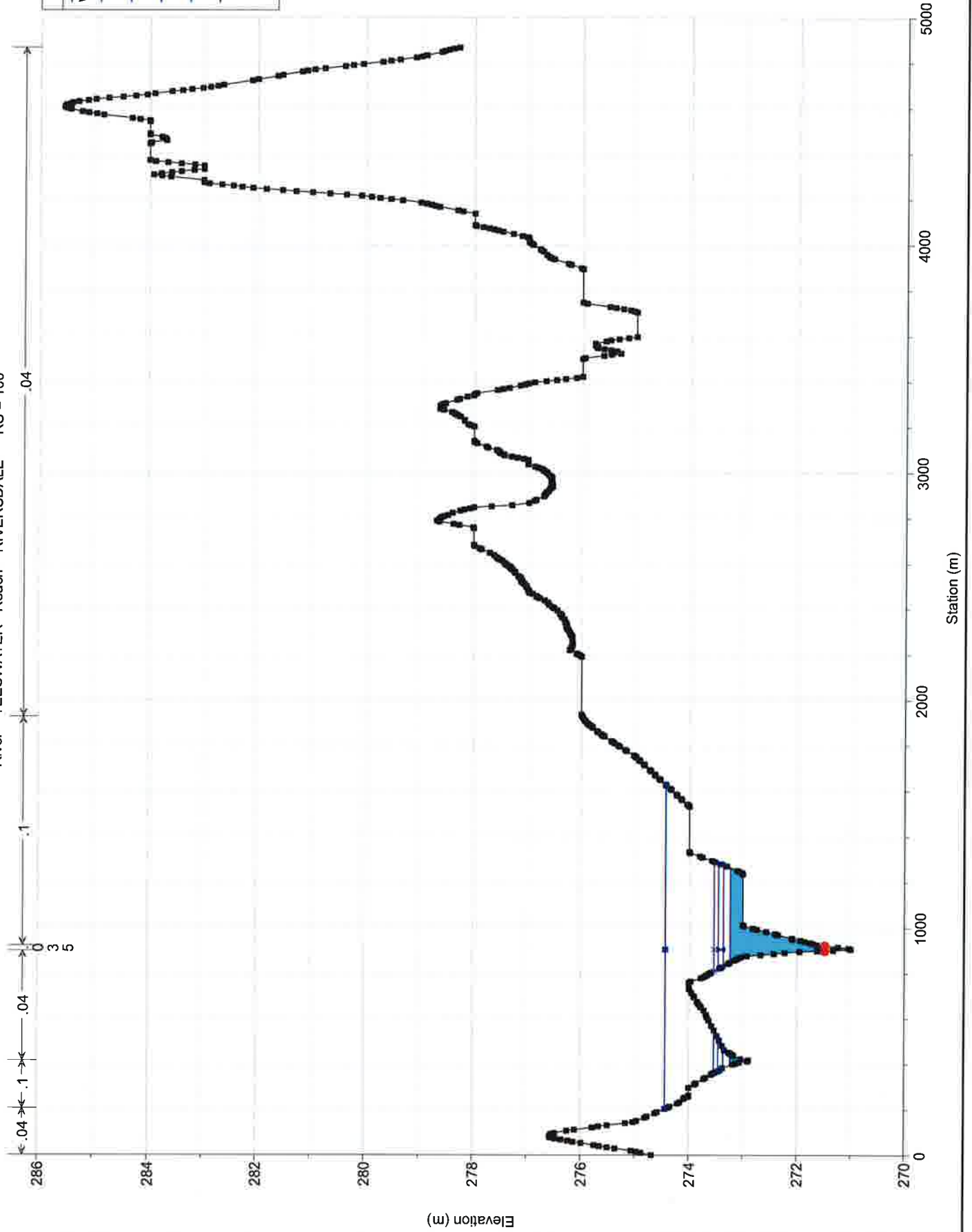
RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018

Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)

River = TEESWATER Reach = RIVERSDALE RS = 101



RIVERSDALE Plan: PR 2 - OFAT INDEX 1/30/2018
 Geom: PROPOSED - WITH EX. BRIDGE AND SR20 EXT. Flow: OFAT INDEX FLOOD (10-100 YR)
 River = TEESWATER Reach = RIVERSDALE RS = 100



APPENDIX E: FLOODPLAIN MODELING – FLOW SENSITIVITY ANALYSIS

HEC-RAS Output Tables
Statistical FFA, MNRF OFAT and MIDUSS Flows

Statistical FFA Flows

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|-----------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 124 | 10-YR | EX-FFA | 66.60 | 271.01 | 273.64 | | 273.65 | 0.000107 | 0.53 | 353.15 | 466.32 | 0.11 |
| RIVERSDALE | 124 | 10-YR | PR-FFA | 66.60 | 271.01 | 273.64 | | 273.64 | 0.000109 | 0.53 | 350.44 | 465.89 | 0.11 |
| RIVERSDALE | 124 | 10-YR | PR 2-FFA | 66.60 | 271.01 | 273.64 | | 273.65 | 0.000107 | 0.52 | 353.52 | 466.38 | 0.11 |
| RIVERSDALE | 124 | 25-YR | EX-FFA | 79.00 | 271.01 | 273.79 | | 273.79 | 0.000092 | 0.51 | 422.23 | 477.13 | 0.10 |
| RIVERSDALE | 124 | 25-YR | PR-FFA | 79.00 | 271.01 | 273.79 | | 273.79 | 0.000092 | 0.51 | 421.07 | 476.95 | 0.10 |
| RIVERSDALE | 124 | 25-YR | PR 2-FFA | 79.00 | 271.01 | 273.79 | | 273.80 | 0.000091 | 0.50 | 423.48 | 477.32 | 0.10 |
| RIVERSDALE | 124 | 50-YR | EX-FFA | 88.40 | 271.01 | 273.88 | | 273.88 | 0.000088 | 0.51 | 463.59 | 483.48 | 0.10 |
| RIVERSDALE | 124 | 50-YR | PR-FFA | 88.40 | 271.01 | 273.88 | | 273.88 | 0.000088 | 0.51 | 463.24 | 483.43 | 0.10 |
| RIVERSDALE | 124 | 50-YR | PR 2-FFA | 88.40 | 271.01 | 273.88 | | 273.88 | 0.000087 | 0.50 | 465.35 | 483.75 | 0.10 |
| RIVERSDALE | 124 | 100-YR | EX-FFA | 97.80 | 271.01 | 273.96 | | 273.96 | 0.000085 | 0.51 | 502.74 | 489.86 | 0.10 |
| RIVERSDALE | 124 | 100-YR | PR-FFA | 97.80 | 271.01 | 273.96 | | 273.96 | 0.000085 | 0.51 | 502.92 | 489.90 | 0.10 |
| RIVERSDALE | 124 | 100-YR | PR 2-FFA | 97.80 | 271.01 | 273.96 | | 273.97 | 0.000084 | 0.51 | 504.86 | 490.23 | 0.10 |
| RIVERSDALE | 124 | REGIONAL | EX-FFA | 734.50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 124 | REGIONAL | PR-FFA | 734.50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 124 | REGIONAL | PR 2-FFA | 734.50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 123 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.63 | | 273.64 | 0.000071 | 0.44 | 417.97 | 585.98 | 0.09 |
| RIVERSDALE | 123 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.63 | | 273.63 | 0.000072 | 0.44 | 414.48 | 582.91 | 0.09 |
| RIVERSDALE | 123 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.64 | | 273.64 | 0.000071 | 0.44 | 418.46 | 586.41 | 0.09 |
| RIVERSDALE | 123 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.78 | | 273.79 | 0.000066 | 0.44 | 511.08 | 677.79 | 0.09 |
| RIVERSDALE | 123 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.78 | | 273.78 | 0.000066 | 0.44 | 509.39 | 677.64 | 0.09 |
| RIVERSDALE | 123 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.78 | | 273.79 | 0.000065 | 0.44 | 512.92 | 677.93 | 0.09 |
| RIVERSDALE | 123 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.87 | | 273.87 | 0.000062 | 0.43 | 570.05 | 682.41 | 0.08 |
| RIVERSDALE | 123 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.87 | | 273.87 | 0.000062 | 0.43 | 569.54 | 682.37 | 0.08 |
| RIVERSDALE | 123 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.87 | | 273.88 | 0.000061 | 0.43 | 572.60 | 682.61 | 0.08 |
| RIVERSDALE | 123 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.95 | | 273.95 | 0.000059 | 0.43 | 625.45 | 687.51 | 0.08 |
| RIVERSDALE | 123 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.95 | | 273.95 | 0.000059 | 0.43 | 625.72 | 687.54 | 0.08 |
| RIVERSDALE | 123 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.95 | | 273.96 | 0.000058 | 0.43 | 628.52 | 687.85 | 0.08 |
| RIVERSDALE | 123 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 123 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 123 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 122 | 10-YR | EX-FFA | 66.60 | 271.81 | 273.63 | | 273.63 | 0.000150 | 0.51 | 404.58 | 454.57 | 0.12 |
| RIVERSDALE | 122 | 10-YR | PR-FFA | 66.60 | 271.81 | 273.62 | | 273.62 | 0.000153 | 0.51 | 401.80 | 453.71 | 0.12 |
| RIVERSDALE | 122 | 10-YR | PR 2-FFA | 66.60 | 271.81 | 273.63 | | 273.63 | 0.000150 | 0.51 | 404.96 | 454.69 | 0.12 |
| RIVERSDALE | 122 | 25-YR | EX-FFA | 79.00 | 271.81 | 273.77 | | 273.78 | 0.000137 | 0.51 | 473.54 | 479.38 | 0.12 |
| RIVERSDALE | 122 | 25-YR | PR-FFA | 79.00 | 271.81 | 273.77 | | 273.78 | 0.000138 | 0.52 | 472.32 | 479.00 | 0.12 |
| RIVERSDALE | 122 | 25-YR | PR 2-FFA | 79.00 | 271.81 | 273.78 | | 273.78 | 0.000136 | 0.51 | 474.87 | 479.79 | 0.12 |
| RIVERSDALE | 122 | 50-YR | EX-FFA | 88.40 | 271.81 | 273.86 | | 273.86 | 0.000135 | 0.53 | 515.71 | 492.79 | 0.12 |
| RIVERSDALE | 122 | 50-YR | PR-FFA | 88.40 | 271.81 | 273.86 | | 273.86 | 0.000135 | 0.53 | 515.34 | 492.68 | 0.12 |
| RIVERSDALE | 122 | 50-YR | PR 2-FFA | 88.40 | 271.81 | 273.86 | | 273.87 | 0.000133 | 0.52 | 517.59 | 493.39 | 0.12 |
| RIVERSDALE | 122 | 100-YR | EX-FFA | 97.80 | 271.81 | 273.94 | | 273.95 | 0.000133 | 0.54 | 556.13 | 505.44 | 0.12 |
| RIVERSDALE | 122 | 100-YR | PR-FFA | 97.80 | 271.81 | 273.94 | | 273.95 | 0.000133 | 0.54 | 556.33 | 505.50 | 0.12 |
| RIVERSDALE | 122 | 100-YR | PR 2-FFA | 97.80 | 271.81 | 273.95 | | 273.95 | 0.000132 | 0.53 | 558.42 | 506.15 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | EX-FFA | 734.50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | PR-FFA | 734.50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | PR 2-FFA | 734.50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 121 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.62 | | 273.62 | 0.000068 | 0.44 | 430.33 | 479.94 | 0.09 |
| RIVERSDALE | 121 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.61 | | 273.62 | 0.000069 | 0.45 | 427.32 | 478.91 | 0.09 |
| RIVERSDALE | 121 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.62 | | 273.62 | 0.000068 | 0.44 | 430.73 | 480.08 | 0.09 |
| RIVERSDALE | 121 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.77 | | 273.77 | 0.000068 | 0.45 | 503.14 | 504.01 | 0.09 |
| RIVERSDALE | 121 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.76 | | 273.77 | 0.000068 | 0.46 | 501.83 | 503.60 | 0.09 |
| RIVERSDALE | 121 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.77 | | 273.77 | 0.000068 | 0.45 | 504.56 | 504.45 | 0.09 |
| RIVERSDALE | 121 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.85 | | 273.86 | 0.000067 | 0.47 | 547.42 | 517.50 | 0.09 |
| RIVERSDALE | 121 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.85 | | 273.86 | 0.000067 | 0.47 | 547.03 | 517.37 | 0.09 |
| RIVERSDALE | 121 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.86 | | 273.86 | 0.000067 | 0.47 | 549.44 | 518.15 | 0.09 |
| RIVERSDALE | 121 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.93 | | 273.94 | 0.000066 | 0.48 | 589.63 | 531.04 | 0.09 |
| RIVERSDALE | 121 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.93 | | 273.94 | 0.000066 | 0.48 | 590.05 | 531.12 | 0.09 |
| RIVERSDALE | 121 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.94 | | 273.94 | 0.000068 | 0.48 | 592.30 | 531.95 | 0.09 |
| RIVERSDALE | 121 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 121 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 121 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 120 | 10-YR | EX-FFA | 66.60 | 271.01 | 273.54 | 272.39 | 273.61 | 0.000696 | 1.27 | 77.42 | 275.34 | 0.27 |
| RIVERSDALE | 120 | 10-YR | PR-FFA | 66.60 | 271.01 | 273.53 | 272.39 | 273.60 | 0.000704 | 1.27 | 77.12 | 274.43 | 0.28 |
| RIVERSDALE | 120 | 10-YR | PR 2-FFA | 66.60 | 271.01 | 273.54 | 272.39 | 273.61 | 0.000695 | 1.27 | 77.46 | 275.46 | 0.27 |
| RIVERSDALE | 120 | 25-YR | EX-FFA | 79.00 | 271.01 | 273.67 | 272.50 | 273.76 | 0.000793 | 1.41 | 83.15 | 315.44 | 0.29 |
| RIVERSDALE | 120 | 25-YR | PR-FFA | 79.00 | 271.01 | 273.67 | 272.50 | 273.75 | 0.000796 | 1.41 | 83.02 | 314.67 | 0.30 |
| RIVERSDALE | 120 | 25-YR | PR 2-FFA | 79.00 | 271.01 | 273.67 | 272.50 | 273.76 | 0.000789 | 1.40 | 83.29 | 316.27 | 0.29 |
| RIVERSDALE | 120 | 50-YR | EX-FFA | 88.40 | 271.01 | 273.74 | 272.58 | 273.84 | 0.000890 | 1.52 | 86.27 | 328.94 | 0.31 |
| RIVERSDALE | 120 | 50-YR | PR-FFA | 88.40 | 271.01 | 273.74 | 272.58 | 273.84 | 0.000891 | 1.52 | 86.23 | 328.86 | 0.31 |
| RIVERSDALE | 120 | 50-YR | PR 2-FFA | 88.40 | 271.01 | 273.75 | 272.58 | 273.84 | 0.000884 | 1.52 | 86.46 | 329.38 | 0.31 |
| RIVERSDALE | 120 | 100-YR | EX-FFA | 97.80 | 271.01 | 273.81 | 272.66 | 273.92 | 0.000989 | 1.63 | 89.11 | 336.20 | 0.33 |
| RIVERSDALE | 120 | 100-YR | PR-FFA | 97.80 | 271.01 | 273.81 | 272.66 | 273.92 | 0.000988 | 1.63 | 89.12 | 336.37 | 0.33 |
| RIVERSDALE | 120 | 100-YR | PR 2-FFA | 97.80 | 271.01 | 273.81 | 272.66 | 273.92 | 0.000981 | 1.63 | 89.34 | 338.27 | 0.33 |
| RIVERSDALE | 120 | REGIONAL | EX-FFA | 734.50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 120 | REGIONAL | PR-FFA | 734.50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 120 | REGIONAL | PR 2-FFA | 734.50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 119.5 | | | | | | | | | | | | |
| RIVERSDALE | 119 | 10-YR | EX-FFA | 66.60 | 271.96 | 273.52 | | 273.55 | 0.000625 | 0.93 | 131.56 | 222.81 | 0.24 |
| RIVERSDALE | 119 | 10-YR | PR-FFA | 66.60 | 271.96 | 273.51 | | 273.54 | 0.000677 | 0.97 | 119.13 | 201.22 | 0.25 |
| RIVERSDALE | 119 | 10-YR | PR 2-FFA | 66.60 | 271.96 | 273.52 | | 273.55 | 0.000684 | 0.97 | 116.83 | 201.65 | 0.25 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W S (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|-----------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 119 | 25-YR | EX-FFA | 79.00 | 271.96 | 273.66 | | 273.69 | 0.000547 | 0.92 | 162.24 | 242.22 | 0.23 |
| RIVERSDALE | 119 | 25-YR | PR-FFA | 79.00 | 271.96 | 273.65 | | 273.68 | 0.000574 | 0.95 | 149.06 | 216.36 | 0.24 |
| RIVERSDALE | 119 | 25-YR | PR 2-FFA | 79.00 | 271.96 | 273.66 | | 273.69 | 0.000590 | 0.96 | 144.97 | 217.33 | 0.24 |
| RIVERSDALE | 119 | 50-YR | EX-FFA | 88.40 | 271.96 | 273.73 | | 273.76 | 0.000538 | 0.94 | 180.15 | 258.35 | 0.23 |
| RIVERSDALE | 119 | 50-YR | PR-FFA | 88.40 | 271.96 | 273.73 | | 273.76 | 0.000552 | 0.96 | 166.50 | 233.43 | 0.23 |
| RIVERSDALE | 119 | 50-YR | PR 2-FFA | 88.40 | 271.96 | 273.73 | | 273.77 | 0.000572 | 0.98 | 161.40 | 234.53 | 0.24 |
| RIVERSDALE | 119 | 100-YR | EX-FFA | 97.80 | 271.96 | 273.80 | | 273.83 | 0.000532 | 0.96 | 197.70 | 275.08 | 0.23 |
| RIVERSDALE | 119 | 100-YR | PR-FFA | 97.80 | 271.96 | 273.80 | | 273.83 | 0.000538 | 0.97 | 183.61 | 251.11 | 0.23 |
| RIVERSDALE | 119 | 100-YR | PR 2-FFA | 97.80 | 271.96 | 273.80 | | 273.84 | 0.000560 | 0.99 | 177.60 | 252.08 | 0.24 |
| RIVERSDALE | 119 | REGIONAL | EX-FFA | 734.50 | 271.96 | 275.29 | | 275.32 | 0.000417 | 1.28 | 1490.01 | 1415.60 | 0.23 |
| RIVERSDALE | 119 | REGIONAL | PR-FFA | 734.50 | 271.96 | 275.30 | | 275.32 | 0.000390 | 1.24 | 1496.98 | 1401.23 | 0.22 |
| RIVERSDALE | 119 | REGIONAL | PR 2-FFA | 734.50 | 271.96 | 275.30 | | 275.33 | 0.000420 | 1.29 | 1451.57 | 1401.37 | 0.23 |
| RIVERSDALE | 118 | 10-YR | EX-FFA | 66.60 | 272.00 | 273.51 | | 273.52 | 0.000300 | 0.65 | 262.72 | 394.18 | 0.17 |
| RIVERSDALE | 118 | 10-YR | PR-FFA | 66.60 | 272.00 | 273.50 | | 273.51 | 0.000307 | 0.65 | 245.75 | 368.27 | 0.17 |
| RIVERSDALE | 118 | 10-YR | PR 2-FFA | 66.60 | 272.00 | 273.51 | | 273.52 | 0.000298 | 0.65 | 248.93 | 369.17 | 0.17 |
| RIVERSDALE | 118 | 25-YR | EX-FFA | 79.00 | 272.00 | 273.65 | | 273.66 | 0.000268 | 0.65 | 318.96 | 408.43 | 0.16 |
| RIVERSDALE | 118 | 25-YR | PR-FFA | 79.00 | 272.00 | 273.64 | | 273.65 | 0.000273 | 0.66 | 300.24 | 383.84 | 0.16 |
| RIVERSDALE | 118 | 25-YR | PR 2-FFA | 79.00 | 272.00 | 273.65 | | 273.66 | 0.000268 | 0.65 | 302.63 | 384.54 | 0.16 |
| RIVERSDALE | 118 | 50-YR | EX-FFA | 88.40 | 272.00 | 273.72 | | 273.73 | 0.000268 | 0.67 | 349.93 | 416.36 | 0.16 |
| RIVERSDALE | 118 | 50-YR | PR-FFA | 88.40 | 272.00 | 273.72 | | 273.73 | 0.000272 | 0.67 | 330.35 | 392.50 | 0.16 |
| RIVERSDALE | 118 | 50-YR | PR 2-FFA | 88.40 | 272.00 | 273.72 | | 273.74 | 0.000268 | 0.67 | 332.43 | 393.09 | 0.16 |
| RIVERSDALE | 118 | 100-YR | EX-FFA | 97.80 | 272.00 | 273.79 | | 273.80 | 0.000270 | 0.69 | 378.85 | 424.36 | 0.17 |
| RIVERSDALE | 118 | 100-YR | PR-FFA | 97.80 | 272.00 | 273.79 | | 273.80 | 0.000274 | 0.70 | 358.28 | 401.10 | 0.17 |
| RIVERSDALE | 118 | 100-YR | PR 2-FFA | 97.80 | 272.00 | 273.79 | | 273.81 | 0.000271 | 0.69 | 360.17 | 401.70 | 0.17 |
| RIVERSDALE | 118 | REGIONAL | EX-FFA | 734.50 | 272.00 | 275.28 | | 275.30 | 0.000276 | 1.05 | 1991.87 | 1483.27 | 0.18 |
| RIVERSDALE | 118 | REGIONAL | PR-FFA | 734.50 | 272.00 | 275.29 | | 275.30 | 0.000273 | 1.04 | 1951.36 | 1469.62 | 0.18 |
| RIVERSDALE | 118 | REGIONAL | PR 2-FFA | 734.50 | 272.00 | 275.29 | | 275.30 | 0.000271 | 1.04 | 1956.09 | 1469.96 | 0.18 |
| RIVERSDALE | 117 | 10-YR | EX-FFA | 66.60 | 272.00 | 273.47 | | 273.49 | 0.000445 | 0.77 | 158.85 | 254.17 | 0.20 |
| RIVERSDALE | 117 | 10-YR | PR-FFA | 66.60 | 272.00 | 273.46 | | 273.48 | 0.000461 | 0.79 | 147.27 | 228.05 | 0.21 |
| RIVERSDALE | 117 | 10-YR | PR 2-FFA | 66.60 | 272.00 | 273.47 | | 273.49 | 0.000447 | 0.78 | 149.51 | 230.78 | 0.21 |
| RIVERSDALE | 117 | 25-YR | EX-FFA | 79.00 | 272.00 | 273.61 | | 273.63 | 0.000378 | 0.76 | 198.69 | 292.05 | 0.19 |
| RIVERSDALE | 117 | 25-YR | PR-FFA | 79.00 | 272.00 | 273.61 | | 273.63 | 0.000393 | 0.77 | 184.58 | 267.68 | 0.20 |
| RIVERSDALE | 117 | 25-YR | PR 2-FFA | 79.00 | 272.00 | 273.62 | | 273.64 | 0.000386 | 0.77 | 186.39 | 269.36 | 0.19 |
| RIVERSDALE | 117 | 50-YR | EX-FFA | 88.40 | 272.00 | 273.69 | | 273.71 | 0.000367 | 0.77 | 221.59 | 310.63 | 0.19 |
| RIVERSDALE | 117 | 50-YR | PR-FFA | 88.40 | 272.00 | 273.69 | | 273.71 | 0.000381 | 0.79 | 205.34 | 287.29 | 0.19 |
| RIVERSDALE | 117 | 50-YR | PR 2-FFA | 88.40 | 272.00 | 273.69 | | 273.71 | 0.000378 | 0.79 | 207.94 | 288.69 | 0.19 |
| RIVERSDALE | 117 | 100-YR | EX-FFA | 97.80 | 272.00 | 273.76 | | 273.78 | 0.000359 | 0.79 | 243.78 | 327.55 | 0.19 |
| RIVERSDALE | 117 | 100-YR | PR-FFA | 97.80 | 272.00 | 273.76 | | 273.78 | 0.000373 | 0.80 | 227.40 | 305.02 | 0.19 |
| RIVERSDALE | 117 | 100-YR | PR 2-FFA | 97.80 | 272.00 | 273.76 | | 273.78 | 0.000371 | 0.80 | 228.86 | 306.20 | 0.19 |
| RIVERSDALE | 117 | REGIONAL | EX-FFA | 734.50 | 272.00 | 275.25 | | 275.27 | 0.000307 | 1.10 | 1604.75 | 1528.95 | 0.19 |
| RIVERSDALE | 117 | REGIONAL | PR-FFA | 734.50 | 272.00 | 275.26 | | 275.28 | 0.000316 | 1.11 | 1569.70 | 1515.95 | 0.20 |
| RIVERSDALE | 117 | REGIONAL | PR 2-FFA | 734.50 | 272.00 | 275.26 | | 275.28 | 0.000322 | 1.13 | 1572.82 | 1516.30 | 0.20 |
| RIVERSDALE | 116 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.41 | | 273.44 | 0.000419 | 0.98 | 156.12 | 241.53 | 0.21 |
| RIVERSDALE | 116 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.40 | | 273.43 | 0.000421 | 0.98 | 145.64 | 214.77 | 0.21 |
| RIVERSDALE | 116 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.41 | | 273.44 | 0.000410 | 0.97 | 148.07 | 217.08 | 0.21 |
| RIVERSDALE | 116 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.56 | | 273.59 | 0.000404 | 1.01 | 193.95 | 270.33 | 0.21 |
| RIVERSDALE | 116 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.55 | | 273.58 | 0.000413 | 1.02 | 180.47 | 245.26 | 0.21 |
| RIVERSDALE | 116 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.56 | | 273.59 | 0.000406 | 1.01 | 182.34 | 246.80 | 0.21 |
| RIVERSDALE | 116 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.63 | | 273.67 | 0.000420 | 1.05 | 214.49 | 284.95 | 0.22 |
| RIVERSDALE | 116 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.63 | | 273.66 | 0.000432 | 1.06 | 199.67 | 260.64 | 0.22 |
| RIVERSDALE | 116 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.63 | | 273.67 | 0.000427 | 1.06 | 201.29 | 262.02 | 0.22 |
| RIVERSDALE | 116 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.70 | | 273.74 | 0.000435 | 1.09 | 234.26 | 299.26 | 0.22 |
| RIVERSDALE | 116 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.70 | | 273.73 | 0.000450 | 1.10 | 218.11 | 275.64 | 0.22 |
| RIVERSDALE | 116 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.70 | | 273.74 | 0.000447 | 1.10 | 219.55 | 276.78 | 0.22 |
| RIVERSDALE | 116 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.17 | | 275.22 | 0.000766 | 1.97 | 1261.21 | 1513.76 | 0.32 |
| RIVERSDALE | 116 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.17 | | 275.22 | 0.000822 | 2.04 | 1215.62 | 1499.87 | 0.33 |
| RIVERSDALE | 116 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.17 | | 275.23 | 0.000826 | 2.04 | 1218.49 | 1500.17 | 0.33 |
| RIVERSDALE | 115 | 10-YR | EX-FFA | 66.60 | 270.07 | 273.39 | | 273.41 | 0.000166 | 0.78 | 206.95 | 201.03 | 0.14 |
| RIVERSDALE | 115 | 10-YR | PR-FFA | 66.60 | 270.07 | 273.38 | | 273.40 | 0.000177 | 0.80 | 187.16 | 175.98 | 0.15 |
| RIVERSDALE | 115 | 10-YR | PR 2-FFA | 66.60 | 270.07 | 273.39 | | 273.41 | 0.000173 | 0.80 | 189.22 | 177.99 | 0.14 |
| RIVERSDALE | 115 | 25-YR | EX-FFA | 79.00 | 270.07 | 273.53 | | 273.56 | 0.000183 | 0.85 | 237.53 | 222.92 | 0.15 |
| RIVERSDALE | 115 | 25-YR | PR-FFA | 79.00 | 270.07 | 273.52 | | 273.55 | 0.000197 | 0.88 | 214.87 | 199.43 | 0.16 |
| RIVERSDALE | 115 | 25-YR | PR 2-FFA | 79.00 | 270.07 | 273.53 | | 273.56 | 0.000194 | 0.87 | 216.46 | 200.67 | 0.15 |
| RIVERSDALE | 115 | 50-YR | EX-FFA | 88.40 | 270.07 | 273.60 | | 273.63 | 0.000203 | 0.91 | 253.62 | 233.47 | 0.16 |
| RIVERSDALE | 115 | 50-YR | PR-FFA | 88.40 | 270.07 | 273.60 | | 273.63 | 0.000220 | 0.94 | 229.84 | 210.62 | 0.16 |
| RIVERSDALE | 115 | 50-YR | PR 2-FFA | 88.40 | 270.07 | 273.60 | | 273.63 | 0.000218 | 0.94 | 231.02 | 211.63 | 0.16 |
| RIVERSDALE | 115 | 100-YR | EX-FFA | 97.80 | 270.07 | 273.67 | | 273.70 | 0.000222 | 0.96 | 269.65 | 295.24 | 0.17 |
| RIVERSDALE | 115 | 100-YR | PR-FFA | 97.80 | 270.07 | 273.66 | | 273.69 | 0.000241 | 1.00 | 244.02 | 256.69 | 0.17 |
| RIVERSDALE | 115 | 100-YR | PR 2-FFA | 97.80 | 270.07 | 273.67 | | 273.70 | 0.000239 | 0.99 | 245.50 | 270.05 | 0.17 |
| RIVERSDALE | 115 | REGIONAL | EX-FFA | 734.50 | 270.07 | 275.15 | | 275.17 | 0.000225 | 1.23 | 2124.43 | 2171.07 | 0.18 |
| RIVERSDALE | 115 | REGIONAL | PR-FFA | 734.50 | 270.07 | 275.15 | | 275.16 | 0.000237 | 1.26 | 2070.07 | 2157.96 | 0.18 |
| RIVERSDALE | 115 | REGIONAL | PR 2-FFA | 734.50 | 270.07 | 275.15 | | 275.17 | 0.000236 | 1.26 | 2075.25 | 2158.33 | 0.18 |
| RIVERSDALE | 114 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.37 | 271.97 | 273.39 | 0.000247 | 0.78 | 226.79 | 795.23 | 0.16 |
| RIVERSDALE | 114 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.36 | | 273.38 | 0.000246 | 0.77 | 222.85 | 760.27 | 0.16 |
| RIVERSDALE | 114 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.37 | 271.97 | 273.39 | 0.000267 | 0.81 | 207.11 | 769.34 | 0.17 |
| RIVERSDALE | 114 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.52 | 272.07 | 273.54 | 0.000177 | 0.69 | 358.64 | 1002.98 | 0.14 |
| RIVERSDALE | 114 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.52 | | 273.53 | 0.000170 | 0.67 | 358.98 | 975.36 | 0.14 |
| RIVERSDALE | 114 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.52 | 272.07 | 273.54 | 0.000186 | 0.70 | 336.46 | 980.95 | 0.14 |
| RIVERSDALE | 114 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.60 | 272.14 | 273.61 | 0.000149 | 0.64 | 432.05 | 1024.01 | 0.13 |
| RIVERSDALE | 114 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.59 | | 273.60 | 0.000145 | 0.64 | 435.07 | 1001.41 | 0.13 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W S Elev (m) | Crit W S (m) | E G Elev (m) | E G Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|-----------------|-----------------|-----------------|--------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 114 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.60 | 272.14 | 273.61 | 0.000159 | 0.67 | 408.52 | 1002.56 | 0.13 |
| RIVERSDALE | 114 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.67 | 272.21 | 273.67 | 0.000130 | 0.61 | 499.67 | 1041.94 | 0.12 |
| RIVERSDALE | 114 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.66 | | 273.67 | 0.000126 | 0.60 | 505.18 | 1019.98 | 0.12 |
| RIVERSDALE | 114 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.67 | 272.21 | 273.67 | 0.000138 | 0.63 | 474.98 | 1020.97 | 0.13 |
| RIVERSDALE | 114 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.14 | 273.82 | 275.15 | 0.000082 | 0.66 | 3148.12 | 2444.97 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.14 | | 275.15 | 0.000074 | 0.63 | 3216.74 | 2433.14 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.14 | 273.83 | 275.15 | 0.000084 | 0.67 | 3100.51 | 2433.29 | 0.11 |
| RIVERSDALE | 113.5 | | | Bridge | | | | | | | | | |
| RIVERSDALE | 113 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.36 | | 273.37 | 0.000073 | 0.42 | 406.47 | 950.18 | 0.09 |
| RIVERSDALE | 113 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.36 | | 273.37 | 0.000074 | 0.42 | 395.79 | 926.09 | 0.09 |
| RIVERSDALE | 113 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.36 | | 273.37 | 0.000073 | 0.42 | 397.46 | 927.10 | 0.09 |
| RIVERSDALE | 113 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.52 | | 273.52 | 0.000050 | 0.36 | 561.25 | 1077.25 | 0.07 |
| RIVERSDALE | 113 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.52 | | 273.52 | 0.000051 | 0.37 | 546.95 | 1053.16 | 0.08 |
| RIVERSDALE | 113 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.52 | | 273.52 | 0.000050 | 0.37 | 548.70 | 1055.10 | 0.07 |
| RIVERSDALE | 113 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.59 | | 273.60 | 0.000045 | 0.35 | 646.21 | 1162.01 | 0.07 |
| RIVERSDALE | 113 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.59 | | 273.60 | 0.000046 | 0.36 | 630.15 | 1137.01 | 0.07 |
| RIVERSDALE | 113 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.59 | | 273.60 | 0.000046 | 0.36 | 632.01 | 1140.33 | 0.07 |
| RIVERSDALE | 113 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.66 | | 273.67 | 0.000042 | 0.35 | 728.91 | 1238.75 | 0.07 |
| RIVERSDALE | 113 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.66 | | 273.66 | 0.000043 | 0.35 | 711.35 | 1214.68 | 0.07 |
| RIVERSDALE | 113 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.66 | | 273.67 | 0.000043 | 0.35 | 713.20 | 1215.54 | 0.07 |
| RIVERSDALE | 113 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000044 | 0.48 | 3946.33 | 2664.10 | 0.08 |
| RIVERSDALE | 113 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000045 | 0.49 | 3905.89 | 2652.29 | 0.08 |
| RIVERSDALE | 113 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000045 | 0.49 | 3906.19 | 2652.31 | 0.08 |
| RIVERSDALE | 112 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.35 | | 273.36 | 0.000160 | 0.62 | 201.42 | 448.13 | 0.13 |
| RIVERSDALE | 112 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.35 | | 273.36 | 0.000160 | 0.62 | 201.42 | 448.13 | 0.13 |
| RIVERSDALE | 112 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.35 | | 273.36 | 0.000160 | 0.62 | 201.42 | 448.13 | 0.13 |
| RIVERSDALE | 112 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.51 | | 273.52 | 0.000140 | 0.60 | 288.87 | 641.46 | 0.12 |
| RIVERSDALE | 112 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.51 | | 273.52 | 0.000140 | 0.60 | 288.87 | 641.46 | 0.12 |
| RIVERSDALE | 112 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.51 | | 273.52 | 0.000140 | 0.60 | 288.87 | 641.46 | 0.12 |
| RIVERSDALE | 112 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.58 | | 273.59 | 0.000137 | 0.61 | 342.48 | 756.18 | 0.12 |
| RIVERSDALE | 112 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.58 | | 273.59 | 0.000137 | 0.61 | 342.48 | 756.18 | 0.12 |
| RIVERSDALE | 112 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.58 | | 273.59 | 0.000137 | 0.61 | 342.48 | 756.18 | 0.12 |
| RIVERSDALE | 112 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.65 | | 273.66 | 0.000132 | 0.61 | 398.07 | 854.40 | 0.12 |
| RIVERSDALE | 112 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.65 | | 273.66 | 0.000132 | 0.61 | 398.07 | 854.40 | 0.12 |
| RIVERSDALE | 112 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.65 | | 273.66 | 0.000132 | 0.61 | 398.07 | 854.40 | 0.12 |
| RIVERSDALE | 112 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 111 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.34 | | 273.35 | 0.000091 | 0.48 | 228.65 | 287.80 | 0.10 |
| RIVERSDALE | 111 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.34 | | 273.35 | 0.000091 | 0.48 | 228.65 | 287.80 | 0.10 |
| RIVERSDALE | 111 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.34 | | 273.35 | 0.000091 | 0.48 | 228.65 | 287.80 | 0.10 |
| RIVERSDALE | 111 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.50 | | 273.51 | 0.000091 | 0.50 | 277.77 | 345.55 | 0.10 |
| RIVERSDALE | 111 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.50 | | 273.51 | 0.000091 | 0.50 | 277.77 | 345.55 | 0.10 |
| RIVERSDALE | 111 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.50 | | 273.51 | 0.000091 | 0.50 | 277.77 | 345.55 | 0.10 |
| RIVERSDALE | 111 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.58 | | 273.58 | 0.000098 | 0.53 | 304.83 | 377.03 | 0.11 |
| RIVERSDALE | 111 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.58 | | 273.58 | 0.000098 | 0.53 | 304.83 | 377.03 | 0.11 |
| RIVERSDALE | 111 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.58 | | 273.58 | 0.000098 | 0.53 | 304.83 | 377.03 | 0.11 |
| RIVERSDALE | 111 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.64 | | 273.65 | 0.000104 | 0.55 | 332.29 | 449.36 | 0.11 |
| RIVERSDALE | 111 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.64 | | 273.65 | 0.000104 | 0.55 | 332.29 | 449.36 | 0.11 |
| RIVERSDALE | 111 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.64 | | 273.65 | 0.000104 | 0.55 | 332.29 | 449.36 | 0.11 |
| RIVERSDALE | 111 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 111 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 111 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 110 | 10-YR | EX-FFA | 66.60 | 270.86 | 273.34 | | 273.34 | 0.000079 | 0.45 | 309.29 | 474.50 | 0.09 |
| RIVERSDALE | 110 | 10-YR | PR-FFA | 66.60 | 270.86 | 273.34 | | 273.34 | 0.000079 | 0.45 | 309.29 | 474.50 | 0.09 |
| RIVERSDALE | 110 | 10-YR | PR 2-FFA | 66.60 | 270.86 | 273.34 | | 273.34 | 0.000079 | 0.45 | 309.29 | 474.50 | 0.09 |
| RIVERSDALE | 110 | 25-YR | EX-FFA | 79.00 | 270.86 | 273.50 | | 273.50 | 0.000065 | 0.42 | 386.09 | 505.42 | 0.09 |
| RIVERSDALE | 110 | 25-YR | PR-FFA | 79.00 | 270.86 | 273.50 | | 273.50 | 0.000065 | 0.42 | 386.09 | 505.42 | 0.09 |
| RIVERSDALE | 110 | 25-YR | PR 2-FFA | 79.00 | 270.86 | 273.50 | | 273.50 | 0.000065 | 0.42 | 386.09 | 505.42 | 0.09 |
| RIVERSDALE | 110 | 50-YR | EX-FFA | 88.40 | 270.86 | 273.57 | | 273.58 | 0.000064 | 0.43 | 424.59 | 517.29 | 0.09 |
| RIVERSDALE | 110 | 50-YR | PR-FFA | 88.40 | 270.86 | 273.57 | | 273.58 | 0.000064 | 0.43 | 424.59 | 517.29 | 0.09 |
| RIVERSDALE | 110 | 50-YR | PR 2-FFA | 88.40 | 270.86 | 273.57 | | 273.58 | 0.000064 | 0.43 | 424.59 | 517.29 | 0.09 |
| RIVERSDALE | 110 | 100-YR | EX-FFA | 97.80 | 270.86 | 273.64 | | 273.64 | 0.000064 | 0.44 | 460.45 | 529.65 | 0.09 |
| RIVERSDALE | 110 | 100-YR | PR-FFA | 97.80 | 270.86 | 273.64 | | 273.64 | 0.000064 | 0.44 | 460.45 | 529.65 | 0.09 |
| RIVERSDALE | 110 | 100-YR | PR 2-FFA | 97.80 | 270.86 | 273.64 | | 273.64 | 0.000064 | 0.44 | 460.45 | 529.65 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | EX-FFA | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | PR-FFA | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | PR 2-FFA | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 109 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.33 | | 273.34 | 0.000093 | 0.48 | 224.01 | 193.04 | 0.10 |
| RIVERSDALE | 109 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.33 | | 273.34 | 0.000093 | 0.48 | 224.01 | 193.04 | 0.10 |
| RIVERSDALE | 109 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.33 | | 273.34 | 0.000093 | 0.48 | 224.01 | 193.04 | 0.10 |
| RIVERSDALE | 109 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.48 | | 273.49 | 0.000101 | 0.52 | 256.10 | 219.36 | 0.11 |
| RIVERSDALE | 109 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.48 | | 273.49 | 0.000101 | 0.52 | 256.10 | 219.36 | 0.11 |
| RIVERSDALE | 109 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.48 | | 273.49 | 0.000101 | 0.52 | 256.10 | 219.36 | 0.11 |
| RIVERSDALE | 109 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.56 | | 273.57 | 0.000111 | 0.56 | 272.68 | 231.36 | 0.11 |
| RIVERSDALE | 109 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.56 | | 273.57 | 0.000111 | 0.56 | 272.68 | 231.36 | 0.11 |
| RIVERSDALE | 109 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.56 | | 273.57 | 0.000111 | 0.56 | 272.68 | 231.36 | 0.11 |
| RIVERSDALE | 109 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.62 | | 273.63 | 0.000121 | 0.60 | 288.49 | 242.10 | 0.12 |
| RIVERSDALE | 109 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.62 | | 273.63 | 0.000121 | 0.60 | 288.49 | 242.10 | 0.12 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 109 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.62 | | 273.63 | 0.000121 | 0.60 | 288.49 | 242.10 | 0.12 |
| RIVERSDALE | 109 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 108 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.30 | | 273.32 | 0.000279 | 0.83 | 189.12 | 245.15 | 0.17 |
| RIVERSDALE | 108 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.30 | | 273.32 | 0.000279 | 0.83 | 189.12 | 245.15 | 0.17 |
| RIVERSDALE | 108 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.30 | | 273.32 | 0.000279 | 0.83 | 189.12 | 245.15 | 0.17 |
| RIVERSDALE | 108 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.45 | | 273.48 | 0.000270 | 0.85 | 229.52 | 268.03 | 0.17 |
| RIVERSDALE | 108 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.45 | | 273.48 | 0.000270 | 0.85 | 229.52 | 268.03 | 0.17 |
| RIVERSDALE | 108 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.45 | | 273.48 | 0.000270 | 0.85 | 229.52 | 268.03 | 0.17 |
| RIVERSDALE | 108 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.53 | | 273.55 | 0.000285 | 0.89 | 249.31 | 278.01 | 0.18 |
| RIVERSDALE | 108 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.53 | | 273.55 | 0.000285 | 0.89 | 249.31 | 278.01 | 0.18 |
| RIVERSDALE | 108 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.53 | | 273.55 | 0.000285 | 0.89 | 249.31 | 278.01 | 0.18 |
| RIVERSDALE | 108 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.59 | | 273.62 | 0.000299 | 0.93 | 267.91 | 287.62 | 0.18 |
| RIVERSDALE | 108 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.59 | | 273.62 | 0.000299 | 0.93 | 267.91 | 287.62 | 0.18 |
| RIVERSDALE | 108 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.59 | | 273.62 | 0.000299 | 0.93 | 267.91 | 287.62 | 0.18 |
| RIVERSDALE | 108 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.15 | 3556.31 | 0.11 |
| RIVERSDALE | 108 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.15 | 3556.31 | 0.11 |
| RIVERSDALE | 108 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.15 | 3556.31 | 0.11 |
| RIVERSDALE | 107 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.28 | | 273.31 | 0.000335 | 0.88 | 184.82 | 256.78 | 0.19 |
| RIVERSDALE | 107 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.28 | | 273.31 | 0.000335 | 0.88 | 184.82 | 256.78 | 0.19 |
| RIVERSDALE | 107 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.28 | | 273.31 | 0.000335 | 0.88 | 184.82 | 256.78 | 0.19 |
| RIVERSDALE | 107 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.44 | | 273.47 | 0.000315 | 0.90 | 227.66 | 283.54 | 0.19 |
| RIVERSDALE | 107 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.44 | | 273.47 | 0.000315 | 0.90 | 227.66 | 283.54 | 0.19 |
| RIVERSDALE | 107 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.44 | | 273.47 | 0.000315 | 0.90 | 227.66 | 283.54 | 0.19 |
| RIVERSDALE | 107 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.51 | | 273.54 | 0.000330 | 0.94 | 248.50 | 295.54 | 0.19 |
| RIVERSDALE | 107 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.51 | | 273.54 | 0.000330 | 0.94 | 248.50 | 295.54 | 0.19 |
| RIVERSDALE | 107 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.51 | | 273.54 | 0.000330 | 0.94 | 248.50 | 295.54 | 0.19 |
| RIVERSDALE | 107 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.58 | | 273.61 | 0.000346 | 0.98 | 268.13 | 308.12 | 0.20 |
| RIVERSDALE | 107 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.58 | | 273.61 | 0.000346 | 0.98 | 268.13 | 308.12 | 0.20 |
| RIVERSDALE | 107 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.58 | | 273.61 | 0.000346 | 0.98 | 268.13 | 308.12 | 0.20 |
| RIVERSDALE | 107 | REGIONAL | EX-FFA | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.68 | 3540.60 | 0.13 |
| RIVERSDALE | 107 | REGIONAL | PR-FFA | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.68 | 3540.60 | 0.13 |
| RIVERSDALE | 107 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.68 | 3540.60 | 0.13 |
| RIVERSDALE | 106 | 10-YR | EX-FFA | 66.60 | 270.01 | 273.25 | | 273.27 | 0.000161 | 0.71 | 197.39 | 249.77 | 0.14 |
| RIVERSDALE | 106 | 10-YR | PR-FFA | 66.60 | 270.01 | 273.25 | | 273.27 | 0.000161 | 0.71 | 197.39 | 249.77 | 0.14 |
| RIVERSDALE | 106 | 10-YR | PR 2-FFA | 66.60 | 270.01 | 273.25 | | 273.27 | 0.000161 | 0.71 | 197.39 | 249.77 | 0.14 |
| RIVERSDALE | 106 | 25-YR | EX-FFA | 79.00 | 270.01 | 273.41 | | 273.43 | 0.000160 | 0.74 | 240.73 | 296.11 | 0.14 |
| RIVERSDALE | 106 | 25-YR | PR-FFA | 79.00 | 270.01 | 273.41 | | 273.43 | 0.000160 | 0.74 | 240.73 | 296.11 | 0.14 |
| RIVERSDALE | 106 | 25-YR | PR 2-FFA | 79.00 | 270.01 | 273.41 | | 273.43 | 0.000160 | 0.74 | 240.73 | 296.11 | 0.14 |
| RIVERSDALE | 106 | 50-YR | EX-FFA | 88.40 | 270.01 | 273.48 | | 273.50 | 0.000171 | 0.78 | 262.23 | 316.81 | 0.14 |
| RIVERSDALE | 106 | 50-YR | PR-FFA | 88.40 | 270.01 | 273.48 | | 273.50 | 0.000171 | 0.78 | 262.23 | 316.81 | 0.14 |
| RIVERSDALE | 106 | 50-YR | PR 2-FFA | 88.40 | 270.01 | 273.48 | | 273.50 | 0.000171 | 0.78 | 262.23 | 316.81 | 0.14 |
| RIVERSDALE | 106 | 100-YR | EX-FFA | 97.80 | 270.01 | 273.54 | | 273.57 | 0.000182 | 0.81 | 282.92 | 335.71 | 0.15 |
| RIVERSDALE | 106 | 100-YR | PR-FFA | 97.80 | 270.01 | 273.54 | | 273.57 | 0.000182 | 0.81 | 282.92 | 335.71 | 0.15 |
| RIVERSDALE | 106 | 100-YR | PR 2-FFA | 97.80 | 270.01 | 273.54 | | 273.57 | 0.000182 | 0.81 | 282.92 | 335.71 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | EX-FFA | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.06 | 3631.21 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | PR-FFA | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.06 | 3631.21 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | PR 2-FFA | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.06 | 3631.21 | 0.15 |
| RIVERSDALE | 105 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.23 | | 273.24 | 0.000104 | 0.50 | 374.07 | 256.98 | 0.11 |
| RIVERSDALE | 105 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.23 | | 273.24 | 0.000104 | 0.50 | 374.07 | 256.98 | 0.11 |
| RIVERSDALE | 105 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.23 | | 273.24 | 0.000104 | 0.50 | 374.07 | 256.98 | 0.11 |
| RIVERSDALE | 105 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.39 | | 273.40 | 0.000112 | 0.54 | 415.92 | 272.99 | 0.11 |
| RIVERSDALE | 105 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.39 | | 273.40 | 0.000112 | 0.54 | 415.92 | 272.99 | 0.11 |
| RIVERSDALE | 105 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.39 | | 273.40 | 0.000112 | 0.54 | 415.92 | 272.99 | 0.11 |
| RIVERSDALE | 105 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.46 | | 273.47 | 0.000125 | 0.58 | 434.69 | 279.16 | 0.12 |
| RIVERSDALE | 105 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.46 | | 273.47 | 0.000125 | 0.58 | 434.69 | 279.16 | 0.12 |
| RIVERSDALE | 105 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.46 | | 273.47 | 0.000125 | 0.58 | 434.69 | 279.16 | 0.12 |
| RIVERSDALE | 105 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.52 | | 273.53 | 0.000138 | 0.62 | 451.93 | 283.58 | 0.12 |
| RIVERSDALE | 105 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.52 | | 273.53 | 0.000138 | 0.62 | 451.93 | 283.58 | 0.12 |
| RIVERSDALE | 105 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.52 | | 273.53 | 0.000138 | 0.62 | 451.93 | 283.58 | 0.12 |
| RIVERSDALE | 105 | REGIONAL | EX-FFA | 734.50 | 271.00 | 274.99 | | 275.04 | 0.000698 | 1.89 | 1346.90 | 1199.05 | 0.30 |
| RIVERSDALE | 105 | REGIONAL | PR-FFA | 734.50 | 271.00 | 274.99 | | 275.04 | 0.000698 | 1.89 | 1346.90 | 1199.05 | 0.30 |
| RIVERSDALE | 105 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 274.99 | | 275.04 | 0.000698 | 1.89 | 1346.90 | 1199.05 | 0.30 |
| RIVERSDALE | 104 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.21 | | 273.22 | 0.000203 | 0.68 | 207.52 | 224.43 | 0.15 |
| RIVERSDALE | 104 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.21 | | 273.22 | 0.000203 | 0.68 | 207.52 | 224.43 | 0.15 |
| RIVERSDALE | 104 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.21 | | 273.22 | 0.000203 | 0.68 | 207.52 | 224.43 | 0.15 |
| RIVERSDALE | 104 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.36 | | 273.38 | 0.000194 | 0.70 | 245.25 | 250.99 | 0.15 |
| RIVERSDALE | 104 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.36 | | 273.38 | 0.000194 | 0.70 | 245.25 | 250.99 | 0.15 |
| RIVERSDALE | 104 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.36 | | 273.38 | 0.000194 | 0.70 | 245.25 | 250.99 | 0.15 |
| RIVERSDALE | 104 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.43 | | 273.44 | 0.000206 | 0.74 | 262.08 | 260.62 | 0.15 |
| RIVERSDALE | 104 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.43 | | 273.44 | 0.000206 | 0.74 | 262.08 | 260.62 | 0.15 |
| RIVERSDALE | 104 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.43 | | 273.44 | 0.000206 | 0.74 | 262.08 | 260.62 | 0.15 |
| RIVERSDALE | 104 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.49 | | 273.50 | 0.000219 | 0.77 | 277.78 | 269.19 | 0.16 |
| RIVERSDALE | 104 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.49 | | 273.50 | 0.000219 | 0.77 | 277.78 | 269.19 | 0.16 |
| RIVERSDALE | 104 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.49 | | 273.50 | 0.000219 | 0.77 | 277.78 | 269.19 | 0.16 |
| RIVERSDALE | 104 | REGIONAL | EX-FFA | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.70 | 907.04 | 0.30 |
| RIVERSDALE | 104 | REGIONAL | PR-FFA | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.70 | 907.04 | 0.30 |
| RIVERSDALE | 104 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.70 | 907.04 | 0.30 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 103 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.17 | | 273.18 | 0.000219 | 0.69 | 205.00 | 230.86 | 0.15 |
| RIVERSDALE | 103 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.17 | | 273.18 | 0.000219 | 0.69 | 205.00 | 230.86 | 0.15 |
| RIVERSDALE | 103 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.17 | | 273.18 | 0.000219 | 0.69 | 205.00 | 230.86 | 0.15 |
| RIVERSDALE | 103 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.33 | | 273.34 | 0.000204 | 0.70 | 243.27 | 244.10 | 0.15 |
| RIVERSDALE | 103 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.33 | | 273.34 | 0.000204 | 0.70 | 243.27 | 244.10 | 0.15 |
| RIVERSDALE | 103 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.33 | | 273.34 | 0.000204 | 0.70 | 243.27 | 244.10 | 0.15 |
| RIVERSDALE | 103 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.39 | | 273.40 | 0.000220 | 0.74 | 258.83 | 249.49 | 0.16 |
| RIVERSDALE | 103 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.39 | | 273.40 | 0.000220 | 0.74 | 258.83 | 249.49 | 0.16 |
| RIVERSDALE | 103 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.39 | | 273.40 | 0.000220 | 0.74 | 258.83 | 249.49 | 0.16 |
| RIVERSDALE | 103 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.45 | | 273.46 | 0.000236 | 0.78 | 273.03 | 254.53 | 0.16 |
| RIVERSDALE | 103 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.45 | | 273.46 | 0.000236 | 0.78 | 273.03 | 254.53 | 0.16 |
| RIVERSDALE | 103 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.45 | | 273.46 | 0.000236 | 0.78 | 273.03 | 254.53 | 0.16 |
| RIVERSDALE | 103 | REGIONAL | EX-FFA | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.93 | 832.33 | 0.34 |
| RIVERSDALE | 103 | REGIONAL | PR-FFA | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.93 | 832.33 | 0.34 |
| RIVERSDALE | 103 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.93 | 832.33 | 0.34 |
| RIVERSDALE | 102 | 10-YR | EX-FFA | 66.60 | 271.00 | 273.13 | | 273.15 | 0.000261 | 0.76 | 233.92 | 290.97 | 0.17 |
| RIVERSDALE | 102 | 10-YR | PR-FFA | 66.60 | 271.00 | 273.13 | | 273.15 | 0.000261 | 0.76 | 233.92 | 290.97 | 0.17 |
| RIVERSDALE | 102 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 273.13 | | 273.15 | 0.000261 | 0.76 | 233.92 | 290.97 | 0.17 |
| RIVERSDALE | 102 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.30 | | 273.31 | 0.000239 | 0.76 | 285.21 | 336.80 | 0.16 |
| RIVERSDALE | 102 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.30 | | 273.31 | 0.000239 | 0.76 | 285.21 | 336.80 | 0.16 |
| RIVERSDALE | 102 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.30 | | 273.31 | 0.000239 | 0.76 | 285.21 | 336.80 | 0.16 |
| RIVERSDALE | 102 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.36 | | 273.37 | 0.000258 | 0.81 | 306.31 | 356.99 | 0.17 |
| RIVERSDALE | 102 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.36 | | 273.37 | 0.000258 | 0.81 | 306.31 | 356.99 | 0.17 |
| RIVERSDALE | 102 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.36 | | 273.37 | 0.000258 | 0.81 | 306.31 | 356.99 | 0.17 |
| RIVERSDALE | 102 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.41 | | 273.43 | 0.000274 | 0.85 | 326.12 | 373.22 | 0.17 |
| RIVERSDALE | 102 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.41 | | 273.43 | 0.000274 | 0.85 | 326.12 | 373.22 | 0.17 |
| RIVERSDALE | 102 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.41 | | 273.43 | 0.000274 | 0.85 | 326.12 | 373.22 | 0.17 |
| RIVERSDALE | 102 | REGIONAL | EX-FFA | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.61 | 1114.24 | 0.27 |
| RIVERSDALE | 102 | REGIONAL | PR-FFA | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.61 | 1114.24 | 0.27 |
| RIVERSDALE | 102 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.61 | 1114.24 | 0.27 |
| RIVERSDALE | 101 | 10-YR | EX-FFA | 66.60 | 271.97 | 273.03 | | 273.05 | 0.000965 | 0.91 | 148.82 | 404.73 | 0.29 |
| RIVERSDALE | 101 | 10-YR | PR-FFA | 66.60 | 271.97 | 273.03 | | 273.05 | 0.000965 | 0.91 | 148.82 | 404.73 | 0.29 |
| RIVERSDALE | 101 | 10-YR | PR 2-FFA | 66.60 | 271.97 | 273.03 | | 273.05 | 0.000965 | 0.91 | 148.82 | 404.73 | 0.29 |
| RIVERSDALE | 101 | 25-YR | EX-FFA | 79.00 | 271.97 | 273.22 | | 273.24 | 0.000514 | 0.75 | 245.12 | 553.16 | 0.21 |
| RIVERSDALE | 101 | 25-YR | PR-FFA | 79.00 | 271.97 | 273.22 | | 273.24 | 0.000514 | 0.75 | 245.12 | 553.16 | 0.21 |
| RIVERSDALE | 101 | 25-YR | PR 2-FFA | 79.00 | 271.97 | 273.22 | | 273.24 | 0.000514 | 0.75 | 245.12 | 553.16 | 0.21 |
| RIVERSDALE | 101 | 50-YR | EX-FFA | 88.40 | 271.97 | 273.29 | | 273.30 | 0.000465 | 0.73 | 280.80 | 589.64 | 0.21 |
| RIVERSDALE | 101 | 50-YR | PR-FFA | 88.40 | 271.97 | 273.29 | | 273.30 | 0.000465 | 0.73 | 280.80 | 589.64 | 0.21 |
| RIVERSDALE | 101 | 50-YR | PR 2-FFA | 88.40 | 271.97 | 273.29 | | 273.30 | 0.000465 | 0.73 | 280.80 | 589.64 | 0.21 |
| RIVERSDALE | 101 | 100-YR | EX-FFA | 97.80 | 271.97 | 273.34 | | 273.35 | 0.000435 | 0.73 | 314.23 | 624.17 | 0.20 |
| RIVERSDALE | 101 | 100-YR | PR-FFA | 97.80 | 271.97 | 273.34 | | 273.35 | 0.000435 | 0.73 | 314.23 | 624.17 | 0.20 |
| RIVERSDALE | 101 | 100-YR | PR 2-FFA | 97.80 | 271.97 | 273.34 | | 273.35 | 0.000435 | 0.73 | 314.23 | 624.17 | 0.20 |
| RIVERSDALE | 101 | REGIONAL | EX-FFA | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000463 | 1.15 | 1474.94 | 1229.21 | 0.23 |
| RIVERSDALE | 101 | REGIONAL | PR-FFA | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000463 | 1.15 | 1474.94 | 1229.21 | 0.23 |
| RIVERSDALE | 101 | REGIONAL | PR 2-FFA | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000463 | 1.15 | 1474.94 | 1229.21 | 0.23 |
| RIVERSDALE | 100 | 10-YR | EX-FFA | 66.60 | 271.00 | 272.87 | 272.17 | 272.93 | 0.001001 | 1.27 | 101.69 | 123.76 | 0.31 |
| RIVERSDALE | 100 | 10-YR | PR-FFA | 66.60 | 271.00 | 272.87 | 272.17 | 272.93 | 0.001001 | 1.27 | 101.69 | 123.76 | 0.31 |
| RIVERSDALE | 100 | 10-YR | PR 2-FFA | 66.60 | 271.00 | 272.87 | 272.17 | 272.93 | 0.001001 | 1.27 | 101.69 | 123.76 | 0.31 |
| RIVERSDALE | 100 | 25-YR | EX-FFA | 79.00 | 271.00 | 273.08 | 272.27 | 273.15 | 0.001001 | 1.38 | 149.88 | 401.95 | 0.32 |
| RIVERSDALE | 100 | 25-YR | PR-FFA | 79.00 | 271.00 | 273.08 | 272.27 | 273.15 | 0.001001 | 1.38 | 149.88 | 401.95 | 0.32 |
| RIVERSDALE | 100 | 25-YR | PR 2-FFA | 79.00 | 271.00 | 273.08 | 272.27 | 273.15 | 0.001001 | 1.38 | 149.88 | 401.95 | 0.32 |
| RIVERSDALE | 100 | 50-YR | EX-FFA | 88.40 | 271.00 | 273.15 | 272.34 | 273.22 | 0.001001 | 1.41 | 177.86 | 429.94 | 0.32 |
| RIVERSDALE | 100 | 50-YR | PR-FFA | 88.40 | 271.00 | 273.15 | 272.34 | 273.22 | 0.001001 | 1.41 | 177.86 | 429.94 | 0.32 |
| RIVERSDALE | 100 | 50-YR | PR 2-FFA | 88.40 | 271.00 | 273.15 | 272.34 | 273.22 | 0.001001 | 1.41 | 177.86 | 429.94 | 0.32 |
| RIVERSDALE | 100 | 100-YR | EX-FFA | 97.80 | 271.00 | 273.20 | 272.42 | 273.27 | 0.001000 | 1.44 | 203.76 | 456.20 | 0.32 |
| RIVERSDALE | 100 | 100-YR | PR-FFA | 97.80 | 271.00 | 273.20 | 272.42 | 273.27 | 0.001000 | 1.44 | 203.76 | 456.20 | 0.32 |
| RIVERSDALE | 100 | 100-YR | PR 2-FFA | 97.80 | 271.00 | 273.20 | 272.42 | 273.27 | 0.001000 | 1.44 | 203.76 | 456.20 | 0.32 |
| RIVERSDALE | 100 | REGIONAL | EX-FFA | 734.50 | 271.00 | 274.44 | 273.89 | 274.49 | 0.001001 | 1.98 | 1370.38 | 1425.35 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | PR-FFA | 734.50 | 271.00 | 274.44 | 273.89 | 274.49 | 0.001001 | 1.98 | 1370.38 | 1425.35 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | PR 2-FFA | 734.50 | 271.00 | 274.44 | 273.89 | 274.49 | 0.001001 | 1.98 | 1370.38 | 1425.35 | 0.35 |

MNRF OFAT Index Flood Flows

| Reach | River Sta | Profile | Plan | Q Total (m ³ /s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Ctnl (m/s) | Flow Area (m ²) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|-----------|--------------------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|--------------------------------|------------------|--------------|
| RIVERSDALE | 124 | 10-YR | EX-OFAT | 103.70 | 271.01 | 274.00 | | 274.01 | 0.000084 | 0.51 | 526.48 | 493.96 | 0.10 |
| RIVERSDALE | 124 | 10-YR | PR-OFAT | 103.70 | 271.01 | 274.01 | | 274.01 | 0.000084 | 0.51 | 526.87 | 494.03 | 0.10 |
| RIVERSDALE | 124 | 10-YR | PR 2-OFAT | 103.70 | 271.01 | 274.01 | | 274.01 | 0.000083 | 0.51 | 528.90 | 494.38 | 0.10 |
| RIVERSDALE | 124 | 25-YR | EX-OFAT | 129.50 | 271.01 | 274.20 | | 274.20 | 0.000079 | 0.52 | 624.53 | 509.66 | 0.10 |
| RIVERSDALE | 124 | 25-YR | PR-OFAT | 129.50 | 271.01 | 274.20 | | 274.21 | 0.000079 | 0.52 | 626.06 | 509.89 | 0.10 |
| RIVERSDALE | 124 | 25-YR | PR 2-OFAT | 129.50 | 271.01 | 274.21 | | 274.21 | 0.000078 | 0.52 | 627.62 | 510.13 | 0.10 |
| RIVERSDALE | 124 | 50-YR | EX-OFAT | 152.40 | 271.01 | 274.35 | | 274.36 | 0.000077 | 0.53 | 703.76 | 522.15 | 0.10 |
| RIVERSDALE | 124 | 50-YR | PR-OFAT | 152.40 | 271.01 | 274.36 | | 274.36 | 0.000077 | 0.53 | 705.22 | 522.39 | 0.10 |
| RIVERSDALE | 124 | 50-YR | PR 2-OFAT | 152.40 | 271.01 | 274.36 | | 274.36 | 0.000076 | 0.53 | 706.84 | 522.66 | 0.10 |
| RIVERSDALE | 124 | 100-YR | EX-OFAT | 175.70 | 271.01 | 274.51 | | 274.52 | 0.000074 | 0.54 | 786.99 | 535.71 | 0.10 |
| RIVERSDALE | 124 | 100-YR | PR-OFAT | 175.70 | 271.01 | 274.51 | | 274.52 | 0.000073 | 0.54 | 788.60 | 535.97 | 0.09 |
| RIVERSDALE | 124 | 100-YR | PR 2-OFAT | 175.70 | 271.01 | 274.52 | | 274.52 | 0.000073 | 0.53 | 790.24 | 536.23 | 0.09 |
| RIVERSDALE | 124 | REGIONAL | EX-OFAT | 734.50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 124 | REGIONAL | PR-OFAT | 734.50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 124 | REGIONAL | PR 2-OFAT | 734.50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 123 | 10-YR | EX-OFAT | 103.70 | 271.00 | 274.00 | | 274.00 | 0.000057 | 0.43 | 658.88 | 691.17 | 0.08 |
| RIVERSDALE | 123 | 10-YR | PR-OFAT | 103.70 | 271.00 | 274.00 | | 274.00 | 0.000057 | 0.43 | 659.46 | 691.23 | 0.08 |
| RIVERSDALE | 123 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 274.00 | | 274.01 | 0.000058 | 0.43 | 662.36 | 756.95 | 0.08 |
| RIVERSDALE | 123 | 25-YR | EX-OFAT | 129.50 | 271.00 | 274.19 | | 274.20 | 0.000053 | 0.43 | 808.42 | 769.19 | 0.08 |
| RIVERSDALE | 123 | 25-YR | PR-OFAT | 129.50 | 271.00 | 274.20 | | 274.20 | 0.000052 | 0.43 | 810.77 | 769.33 | 0.08 |
| RIVERSDALE | 123 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 274.20 | | 274.20 | 0.000052 | 0.43 | 813.17 | 769.48 | 0.08 |
| RIVERSDALE | 123 | 50-YR | EX-OFAT | 152.40 | 271.00 | 274.35 | | 274.35 | 0.000049 | 0.43 | 927.53 | 776.39 | 0.08 |
| RIVERSDALE | 123 | 50-YR | PR-OFAT | 152.40 | 271.00 | 274.35 | | 274.35 | 0.000049 | 0.43 | 929.74 | 776.52 | 0.08 |
| RIVERSDALE | 123 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 274.35 | | 274.36 | 0.000049 | 0.43 | 932.15 | 776.67 | 0.08 |
| RIVERSDALE | 123 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.51 | | 274.51 | 0.000046 | 0.43 | 1050.72 | 784.38 | 0.06 |
| RIVERSDALE | 123 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.51 | | 274.51 | 0.000045 | 0.43 | 1053.10 | 784.54 | 0.07 |
| RIVERSDALE | 123 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.51 | | 274.51 | 0.000045 | 0.43 | 1055.54 | 784.71 | 0.07 |
| RIVERSDALE | 123 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 123 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 123 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 122 | 10-YR | EX-OFAT | 103.70 | 271.81 | 273.99 | | 273.99 | 0.000134 | 0.55 | 580.88 | 516.68 | 0.12 |
| RIVERSDALE | 122 | 10-YR | PR-OFAT | 103.70 | 271.81 | 273.99 | | 274.00 | 0.000133 | 0.55 | 581.29 | 516.96 | 0.12 |
| RIVERSDALE | 122 | 10-YR | PR 2-OFAT | 103.70 | 271.81 | 274.00 | | 274.00 | 0.000132 | 0.54 | 583.34 | 518.32 | 0.12 |
| RIVERSDALE | 122 | 25-YR | EX-OFAT | 129.50 | 271.81 | 274.19 | | 274.19 | 0.000139 | 0.59 | 729.06 | 776.13 | 0.12 |
| RIVERSDALE | 122 | 25-YR | PR-OFAT | 129.50 | 271.81 | 274.19 | | 274.19 | 0.000138 | 0.59 | 731.48 | 776.33 | 0.12 |
| RIVERSDALE | 122 | 25-YR | PR 2-OFAT | 129.50 | 271.81 | 274.19 | | 274.20 | 0.000136 | 0.59 | 733.97 | 776.53 | 0.12 |
| RIVERSDALE | 122 | 50-YR | EX-OFAT | 152.40 | 271.81 | 274.34 | | 274.34 | 0.000123 | 0.58 | 850.00 | 785.92 | 0.12 |
| RIVERSDALE | 122 | 50-YR | PR-OFAT | 152.40 | 271.81 | 274.34 | | 274.35 | 0.000122 | 0.58 | 852.30 | 786.11 | 0.12 |
| RIVERSDALE | 122 | 50-YR | PR 2-OFAT | 152.40 | 271.81 | 274.35 | | 274.35 | 0.000121 | 0.58 | 854.77 | 786.30 | 0.12 |
| RIVERSDALE | 122 | 100-YR | EX-OFAT | 175.70 | 271.81 | 274.50 | | 274.50 | 0.000108 | 0.57 | 975.50 | 796.78 | 0.11 |
| RIVERSDALE | 122 | 100-YR | PR-OFAT | 175.70 | 271.81 | 274.50 | | 274.51 | 0.000107 | 0.56 | 977.95 | 797.01 | 0.11 |
| RIVERSDALE | 122 | 100-YR | PR 2-OFAT | 175.70 | 271.81 | 274.51 | | 274.51 | 0.000106 | 0.56 | 980.45 | 797.25 | 0.11 |
| RIVERSDALE | 122 | REGIONAL | EX-OFAT | 734.50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | PR-OFAT | 734.50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | PR 2-OFAT | 734.50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 121 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.98 | | 273.99 | 0.000069 | 0.49 | 615.78 | 541.92 | 0.09 |
| RIVERSDALE | 121 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.98 | | 273.99 | 0.000069 | 0.49 | 616.26 | 542.17 | 0.09 |
| RIVERSDALE | 121 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.99 | | 273.99 | 0.000069 | 0.49 | 618.44 | 543.29 | 0.09 |
| RIVERSDALE | 121 | 25-YR | EX-OFAT | 129.50 | 271.00 | 274.18 | | 274.18 | 0.000078 | 0.54 | 762.20 | 779.02 | 0.10 |
| RIVERSDALE | 121 | 25-YR | PR-OFAT | 129.50 | 271.00 | 274.18 | | 274.19 | 0.000078 | 0.54 | 764.70 | 779.22 | 0.10 |
| RIVERSDALE | 121 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 274.18 | | 274.19 | 0.000077 | 0.54 | 767.23 | 779.43 | 0.10 |
| RIVERSDALE | 121 | 50-YR | EX-OFAT | 152.40 | 271.00 | 274.33 | | 274.34 | 0.000074 | 0.55 | 884.10 | 788.73 | 0.10 |
| RIVERSDALE | 121 | 50-YR | PR-OFAT | 152.40 | 271.00 | 274.34 | | 274.34 | 0.000074 | 0.54 | 886.45 | 788.90 | 0.10 |
| RIVERSDALE | 121 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 274.34 | | 274.34 | 0.000073 | 0.54 | 888.99 | 789.08 | 0.10 |
| RIVERSDALE | 121 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.49 | | 274.50 | 0.000069 | 0.54 | 1010.51 | 797.69 | 0.09 |
| RIVERSDALE | 121 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.50 | | 274.50 | 0.000068 | 0.54 | 1013.00 | 797.87 | 0.09 |
| RIVERSDALE | 121 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.50 | | 274.50 | 0.000069 | 0.54 | 1015.57 | 798.05 | 0.09 |
| RIVERSDALE | 121 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 121 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 121 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 120 | 10-YR | EX-OFAT | 103.70 | 271.01 | 273.85 | 272.70 | 273.97 | 0.001052 | 1.70 | 90.76 | 348.12 | 0.34 |
| RIVERSDALE | 120 | 10-YR | PR-OFAT | 103.70 | 271.01 | 273.85 | 272.70 | 273.97 | 0.001050 | 1.70 | 90.81 | 348.27 | 0.34 |
| RIVERSDALE | 120 | 10-YR | PR 2-OFAT | 103.70 | 271.01 | 273.85 | 272.70 | 273.97 | 0.001043 | 1.70 | 91.01 | 360.36 | 0.34 |
| RIVERSDALE | 120 | 25-YR | EX-OFAT | 129.50 | 271.01 | 273.99 | 272.90 | 274.16 | 0.001338 | 1.99 | 97.13 | 420.59 | 0.39 |
| RIVERSDALE | 120 | 25-YR | PR-OFAT | 129.50 | 271.01 | 273.99 | 272.90 | 274.16 | 0.001331 | 1.99 | 97.30 | 422.54 | 0.39 |
| RIVERSDALE | 120 | 25-YR | PR 2-OFAT | 129.50 | 271.01 | 274.00 | 272.90 | 274.16 | 0.001324 | 1.98 | 97.47 | 424.52 | 0.39 |
| RIVERSDALE | 120 | 50-YR | EX-OFAT | 152.40 | 271.01 | 274.10 | 273.05 | 274.31 | 0.001605 | 2.24 | 101.83 | 769.75 | 0.43 |
| RIVERSDALE | 120 | 50-YR | PR-OFAT | 152.40 | 271.01 | 274.10 | 273.05 | 274.31 | 0.001597 | 2.24 | 102.00 | 770.15 | 0.43 |
| RIVERSDALE | 120 | 50-YR | PR 2-OFAT | 152.40 | 271.01 | 274.11 | 273.05 | 274.31 | 0.001589 | 2.23 | 102.17 | 770.58 | 0.43 |
| RIVERSDALE | 120 | 100-YR | EX-OFAT | 175.70 | 271.01 | 274.21 | 273.19 | 274.46 | 0.001853 | 2.47 | 106.67 | 780.88 | 0.47 |
| RIVERSDALE | 120 | 100-YR | PR-OFAT | 175.70 | 271.01 | 274.21 | 273.19 | 274.47 | 0.001843 | 2.47 | 106.85 | 781.23 | 0.47 |
| RIVERSDALE | 120 | 100-YR | PR 2-OFAT | 175.70 | 271.01 | 274.22 | 273.19 | 274.47 | 0.001833 | 2.46 | 107.03 | 781.55 | 0.46 |
| RIVERSDALE | 120 | REGIONAL | EX-OFAT | 734.50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 120 | REGIONAL | PR-OFAT | 734.50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 120 | REGIONAL | PR 2-OFAT | 734.50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 119.5 | | | Bridge | | | | | | | | | |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|-----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 119 | 10-YR | EX-OFAT | 103.70 | 271.95 | 273.84 | | 273.87 | 0.000537 | 0.98 | 208.62 | 299.53 | 0.23 |
| RIVERSDALE | 119 | 10-YR | PR-OFAT | 103.70 | 271.95 | 273.84 | | 273.87 | 0.000531 | 0.98 | 194.45 | 276.45 | 0.23 |
| RIVERSDALE | 119 | 10-YR | PR 2-OFAT | 103.70 | 271.95 | 273.84 | | 273.88 | 0.000555 | 1.00 | 187.88 | 278.14 | 0.24 |
| RIVERSDALE | 119 | 25-YR | EX-OFAT | 129.50 | 271.95 | 274.00 | | 274.03 | 0.000523 | 1.03 | 259.42 | 378.12 | 0.23 |
| RIVERSDALE | 119 | 25-YR | PR-OFAT | 129.50 | 271.96 | 274.00 | | 274.03 | 0.000531 | 1.04 | 246.28 | 589.70 | 0.24 |
| RIVERSDALE | 119 | 25-YR | PR 2-OFAT | 129.50 | 271.96 | 274.01 | | 274.04 | 0.000549 | 1.05 | 237.14 | 591.21 | 0.24 |
| RIVERSDALE | 119 | 50-YR | EX-OFAT | 152.40 | 271.96 | 274.12 | | 274.15 | 0.000516 | 1.06 | 333.12 | 666.56 | 0.23 |
| RIVERSDALE | 119 | 50-YR | PR-OFAT | 152.40 | 271.96 | 274.13 | | 274.15 | 0.000480 | 1.02 | 322.66 | 646.66 | 0.23 |
| RIVERSDALE | 119 | 50-YR | PR 2-OFAT | 152.40 | 271.96 | 274.13 | | 274.16 | 0.000504 | 1.05 | 309.71 | 647.62 | 0.23 |
| RIVERSDALE | 119 | 100-YR | EX-OFAT | 175.70 | 271.96 | 274.24 | | 274.27 | 0.000474 | 1.06 | 414.07 | 709.58 | 0.23 |
| RIVERSDALE | 119 | 100-YR | PR-OFAT | 175.70 | 271.96 | 274.25 | | 274.28 | 0.000439 | 1.02 | 405.39 | 690.46 | 0.22 |
| RIVERSDALE | 119 | 100-YR | PR 2-OFAT | 175.70 | 271.96 | 274.25 | | 274.28 | 0.000468 | 1.05 | 388.54 | 691.34 | 0.23 |
| RIVERSDALE | 119 | REGIONAL | EX-OFAT | 734.50 | 271.96 | 275.29 | | 275.32 | 0.000417 | 1.28 | 1490.01 | 1415.60 | 0.23 |
| RIVERSDALE | 119 | REGIONAL | PR-OFAT | 734.50 | 271.96 | 275.30 | | 275.32 | 0.000390 | 1.24 | 1496.98 | 1401.23 | 0.22 |
| RIVERSDALE | 119 | REGIONAL | PR 2-OFAT | 734.50 | 271.96 | 275.30 | | 275.33 | 0.000420 | 1.29 | 1451.57 | 1401.37 | 0.23 |
| RIVERSDALE | 118 | 10-YR | EX-OFAT | 103.70 | 272.00 | 273.83 | | 273.84 | 0.000272 | 0.70 | 396.05 | 429.28 | 0.17 |
| RIVERSDALE | 118 | 10-YR | PR-OFAT | 103.70 | 272.00 | 273.83 | | 273.85 | 0.000276 | 0.71 | 374.94 | 406.38 | 0.17 |
| RIVERSDALE | 118 | 10-YR | PR 2-OFAT | 103.70 | 272.00 | 273.84 | | 273.85 | 0.000273 | 0.71 | 376.71 | 406.95 | 0.17 |
| RIVERSDALE | 118 | 25-YR | EX-OFAT | 129.50 | 272.00 | 273.99 | | 274.00 | 0.000283 | 0.76 | 465.61 | 451.55 | 0.17 |
| RIVERSDALE | 118 | 25-YR | PR-OFAT | 129.50 | 272.00 | 273.99 | | 274.01 | 0.000287 | 0.76 | 442.05 | 429.96 | 0.17 |
| RIVERSDALE | 118 | 25-YR | PR 2-OFAT | 129.50 | 272.00 | 274.00 | | 274.01 | 0.000284 | 0.76 | 443.66 | 430.47 | 0.17 |
| RIVERSDALE | 118 | 50-YR | EX-OFAT | 152.40 | 272.00 | 274.11 | | 274.12 | 0.000296 | 0.81 | 552.87 | 801.74 | 0.18 |
| RIVERSDALE | 118 | 50-YR | PR-OFAT | 152.40 | 272.00 | 274.11 | | 274.13 | 0.000290 | 0.80 | 529.31 | 807.12 | 0.18 |
| RIVERSDALE | 118 | 50-YR | PR 2-OFAT | 152.40 | 272.00 | 274.12 | | 274.13 | 0.000288 | 0.80 | 532.11 | 809.81 | 0.18 |
| RIVERSDALE | 118 | 100-YR | EX-OFAT | 175.70 | 272.00 | 274.23 | | 274.25 | 0.000269 | 0.80 | 669.21 | 989.08 | 0.17 |
| RIVERSDALE | 118 | 100-YR | PR-OFAT | 175.70 | 272.00 | 274.24 | | 274.25 | 0.000266 | 0.80 | 644.18 | 971.35 | 0.17 |
| RIVERSDALE | 118 | 100-YR | PR 2-OFAT | 175.70 | 272.00 | 274.24 | | 274.26 | 0.000263 | 0.79 | 647.57 | 973.18 | 0.17 |
| RIVERSDALE | 118 | REGIONAL | EX-OFAT | 734.50 | 272.00 | 275.28 | | 275.30 | 0.000276 | 1.05 | 1991.87 | 1483.27 | 0.18 |
| RIVERSDALE | 118 | REGIONAL | PR-OFAT | 734.50 | 272.00 | 275.29 | | 275.30 | 0.000273 | 1.04 | 1951.36 | 1469.62 | 0.18 |
| RIVERSDALE | 118 | REGIONAL | PR 2-OFAT | 734.50 | 272.00 | 275.29 | | 275.30 | 0.000271 | 1.04 | 1956.09 | 1469.96 | 0.18 |
| RIVERSDALE | 117 | 10-YR | EX-OFAT | 103.70 | 272.00 | 273.80 | | 273.82 | 0.000354 | 0.79 | 257.32 | 337.55 | 0.19 |
| RIVERSDALE | 117 | 10-YR | PR-OFAT | 103.70 | 272.00 | 273.80 | | 273.82 | 0.000369 | 0.81 | 240.31 | 315.47 | 0.19 |
| RIVERSDALE | 117 | 10-YR | PR 2-OFAT | 103.70 | 272.00 | 273.80 | | 273.82 | 0.000368 | 0.81 | 241.70 | 316.59 | 0.19 |
| RIVERSDALE | 117 | 25-YR | EX-OFAT | 129.50 | 272.00 | 273.98 | | 273.98 | 0.000340 | 0.82 | 314.31 | 376.24 | 0.19 |
| RIVERSDALE | 117 | 25-YR | PR-OFAT | 129.50 | 272.00 | 273.98 | | 273.98 | 0.000354 | 0.84 | 294.73 | 355.67 | 0.19 |
| RIVERSDALE | 117 | 25-YR | PR 2-OFAT | 129.50 | 272.00 | 273.97 | | 273.99 | 0.000356 | 0.84 | 295.97 | 356.47 | 0.19 |
| RIVERSDALE | 117 | 50-YR | EX-OFAT | 152.40 | 272.00 | 274.08 | | 274.10 | 0.000332 | 0.85 | 372.76 | 548.30 | 0.19 |
| RIVERSDALE | 117 | 50-YR | PR-OFAT | 152.40 | 272.00 | 274.08 | | 274.10 | 0.000346 | 0.86 | 351.70 | 529.27 | 0.19 |
| RIVERSDALE | 117 | 50-YR | PR 2-OFAT | 152.40 | 272.00 | 274.09 | | 274.11 | 0.000348 | 0.87 | 353.39 | 530.55 | 0.19 |
| RIVERSDALE | 117 | 100-YR | EX-OFAT | 175.70 | 272.00 | 274.21 | | 274.23 | 0.000295 | 0.83 | 447.21 | 634.02 | 0.18 |
| RIVERSDALE | 117 | 100-YR | PR-OFAT | 175.70 | 272.00 | 274.21 | | 274.23 | 0.000309 | 0.85 | 424.21 | 617.29 | 0.18 |
| RIVERSDALE | 117 | 100-YR | PR 2-OFAT | 175.70 | 272.00 | 274.22 | | 274.23 | 0.000311 | 0.85 | 426.13 | 619.69 | 0.18 |
| RIVERSDALE | 117 | REGIONAL | EX-OFAT | 734.50 | 272.00 | 275.25 | | 275.27 | 0.000307 | 1.10 | 1604.75 | 1528.95 | 0.19 |
| RIVERSDALE | 117 | REGIONAL | PR-OFAT | 734.50 | 272.00 | 275.26 | | 275.28 | 0.000316 | 1.11 | 1568.70 | 1515.95 | 0.20 |
| RIVERSDALE | 117 | REGIONAL | PR 2-OFAT | 734.50 | 272.00 | 275.26 | | 275.28 | 0.000322 | 1.13 | 1572.82 | 1516.30 | 0.20 |
| RIVERSDALE | 116 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.74 | | 273.78 | 0.000444 | 1.11 | 246.29 | 307.65 | 0.22 |
| RIVERSDALE | 116 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.74 | | 273.77 | 0.000461 | 1.13 | 229.37 | 284.41 | 0.23 |
| RIVERSDALE | 116 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.74 | | 273.78 | 0.000458 | 1.13 | 230.72 | 285.44 | 0.23 |
| RIVERSDALE | 116 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.90 | | 273.93 | 0.000477 | 1.20 | 296.67 | 338.99 | 0.23 |
| RIVERSDALE | 116 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.89 | | 273.94 | 0.000501 | 1.23 | 276.60 | 317.01 | 0.24 |
| RIVERSDALE | 116 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.90 | | 273.94 | 0.000501 | 1.23 | 277.71 | 317.77 | 0.24 |
| RIVERSDALE | 116 | 50-YR | EX-OFAT | 152.40 | 271.00 | 274.01 | | 274.05 | 0.000500 | 1.26 | 338.75 | 399.00 | 0.24 |
| RIVERSDALE | 116 | 50-YR | PR-OFAT | 152.40 | 271.00 | 274.01 | | 274.06 | 0.000529 | 1.30 | 316.21 | 377.38 | 0.25 |
| RIVERSDALE | 116 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 274.02 | | 274.06 | 0.000530 | 1.30 | 317.33 | 379.08 | 0.25 |
| RIVERSDALE | 116 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.14 | | 274.18 | 0.000488 | 1.29 | 394.19 | 454.20 | 0.24 |
| RIVERSDALE | 116 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.14 | | 274.19 | 0.000521 | 1.33 | 368.96 | 433.70 | 0.25 |
| RIVERSDALE | 116 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.15 | | 274.19 | 0.000522 | 1.33 | 370.17 | 434.76 | 0.25 |
| RIVERSDALE | 116 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.17 | | 275.22 | 0.000766 | 1.97 | 1261.21 | 1513.76 | 0.32 |
| RIVERSDALE | 116 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.17 | | 275.22 | 0.000822 | 2.04 | 1215.62 | 1499.87 | 0.33 |
| RIVERSDALE | 116 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.17 | | 275.23 | 0.000826 | 2.04 | 1218.49 | 1500.17 | 0.33 |
| RIVERSDALE | 115 | 10-YR | EX-OFAT | 103.70 | 270.07 | 273.71 | | 273.74 | 0.000233 | 0.99 | 282.47 | 373.04 | 0.17 |
| RIVERSDALE | 115 | 10-YR | PR-OFAT | 103.70 | 270.07 | 273.70 | | 273.73 | 0.000254 | 1.03 | 255.54 | 345.24 | 0.18 |
| RIVERSDALE | 115 | 10-YR | PR 2-OFAT | 103.70 | 270.07 | 273.70 | | 273.74 | 0.000252 | 1.03 | 257.34 | 350.59 | 0.18 |
| RIVERSDALE | 115 | 25-YR | EX-OFAT | 129.50 | 270.07 | 273.86 | | 273.89 | 0.000265 | 1.08 | 350.41 | 522.98 | 0.18 |
| RIVERSDALE | 115 | 25-YR | PR-OFAT | 129.50 | 270.07 | 273.85 | | 273.89 | 0.000291 | 1.14 | 319.52 | 498.40 | 0.19 |
| RIVERSDALE | 115 | 25-YR | PR 2-OFAT | 129.50 | 270.07 | 273.86 | | 273.89 | 0.000289 | 1.13 | 321.56 | 501.16 | 0.19 |
| RIVERSDALE | 115 | 50-YR | EX-OFAT | 152.40 | 270.07 | 273.98 | | 274.01 | 0.000274 | 1.13 | 416.12 | 576.91 | 0.19 |
| RIVERSDALE | 115 | 50-YR | PR-OFAT | 152.40 | 270.07 | 273.97 | | 274.01 | 0.000303 | 1.18 | 382.74 | 555.47 | 0.20 |
| RIVERSDALE | 115 | 50-YR | PR 2-OFAT | 152.40 | 270.07 | 273.97 | | 274.01 | 0.000301 | 1.18 | 384.72 | 556.61 | 0.20 |
| RIVERSDALE | 115 | 100-YR | EX-OFAT | 175.70 | 270.07 | 274.11 | | 274.14 | 0.000269 | 1.14 | 524.41 | 930.95 | 0.19 |
| RIVERSDALE | 115 | 100-YR | PR-OFAT | 175.70 | 270.07 | 274.10 | | 274.14 | 0.000298 | 1.20 | 486.54 | 893.51 | 0.20 |
| RIVERSDALE | 115 | 100-YR | PR 2-OFAT | 175.70 | 270.07 | 274.10 | | 274.14 | 0.000295 | 1.20 | 489.67 | 904.42 | 0.20 |
| RIVERSDALE | 115 | REGIONAL | EX-OFAT | 734.50 | 270.07 | 275.15 | | 275.17 | 0.000225 | 1.23 | 2124.43 | 2171.07 | 0.18 |
| RIVERSDALE | 115 | REGIONAL | PR-OFAT | 734.50 | 270.07 | 275.15 | | 275.16 | 0.000237 | 1.26 | 2070.07 | 2157.96 | 0.18 |
| RIVERSDALE | 115 | REGIONAL | PR 2-OFAT | 734.50 | 270.07 | 275.15 | | 275.17 | 0.000236 | 1.26 | 2075.25 | 2158.33 | 0.18 |
| RIVERSDALE | 114 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.71 | 272.26 | 273.71 | 0.000120 | 0.60 | 539.59 | 1051.69 | 0.12 |
| RIVERSDALE | 114 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.70 | | 273.71 | 0.000117 | 0.59 | 546.57 | 1030.22 | 0.12 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|-----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 114 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.71 | 272.25 | 273.71 | 0.000128 | 0.61 | 514.27 | 1031.04 | 0.12 |
| RIVERSDALE | 114 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.86 | 272.44 | 273.87 | 0.000095 | 0.55 | 700.07 | 1090.15 | 0.11 |
| RIVERSDALE | 114 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.86 | | 273.87 | 0.000091 | 0.54 | 712.62 | 1069.93 | 0.10 |
| RIVERSDALE | 114 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.86 | 272.46 | 273.87 | 0.000100 | 0.56 | 671.89 | 1070.51 | 0.11 |
| RIVERSDALE | 114 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.98 | 272.62 | 273.99 | 0.000084 | 0.53 | 826.33 | 1124.98 | 0.10 |
| RIVERSDALE | 114 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.98 | | 273.98 | 0.000080 | 0.52 | 843.37 | 1105.19 | 0.10 |
| RIVERSDALE | 114 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.98 | 272.59 | 273.99 | 0.000088 | 0.54 | 796.00 | 1106.05 | 0.10 |
| RIVERSDALE | 114 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.11 | 272.76 | 274.12 | 0.000080 | 0.54 | 1025.91 | 1702.67 | 0.10 |
| RIVERSDALE | 114 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.11 | | 274.11 | 0.000077 | 0.52 | 1046.81 | 1681.70 | 0.10 |
| RIVERSDALE | 114 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.11 | 272.72 | 274.12 | 0.000084 | 0.55 | 993.01 | 1684.24 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.14 | 273.82 | 275.15 | 0.000082 | 0.66 | 3148.12 | 2444.97 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.14 | | 275.15 | 0.000074 | 0.63 | 3216.74 | 2433.14 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.14 | 273.83 | 275.15 | 0.000084 | 0.67 | 3100.51 | 2433.29 | 0.11 |
| RIVERSDALE | 113.5 | | | Bridge | | | | | | | | | |
| RIVERSDALE | 113 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.70 | | 273.71 | 0.000041 | 0.34 | 778.90 | 1259.22 | 0.07 |
| RIVERSDALE | 113 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.70 | | 273.70 | 0.000042 | 0.35 | 760.56 | 1237.63 | 0.07 |
| RIVERSDALE | 113 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.70 | | 273.71 | 0.000041 | 0.35 | 762.37 | 1238.28 | 0.07 |
| RIVERSDALE | 113 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.86 | | 273.86 | 0.000036 | 0.34 | 981.98 | 1324.64 | 0.06 |
| RIVERSDALE | 113 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.86 | | 273.86 | 0.000037 | 0.34 | 960.71 | 1304.24 | 0.07 |
| RIVERSDALE | 113 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.86 | | 273.86 | 0.000037 | 0.34 | 962.24 | 1304.70 | 0.07 |
| RIVERSDALE | 113 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.98 | | 273.98 | 0.000034 | 0.34 | 1143.64 | 1372.56 | 0.06 |
| RIVERSDALE | 113 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.98 | | 273.98 | 0.000035 | 0.34 | 1120.25 | 1352.95 | 0.06 |
| RIVERSDALE | 113 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.98 | | 273.98 | 0.000035 | 0.34 | 1121.56 | 1353.38 | 0.06 |
| RIVERSDALE | 113 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.11 | | 274.11 | 0.000035 | 0.35 | 1403.30 | 2175.02 | 0.06 |
| RIVERSDALE | 113 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.11 | | 274.11 | 0.000036 | 0.36 | 1376.57 | 2155.77 | 0.07 |
| RIVERSDALE | 113 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.11 | | 274.11 | 0.000036 | 0.36 | 1378.70 | 2156.63 | 0.07 |
| RIVERSDALE | 113 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000044 | 0.48 | 3946.33 | 2664.10 | 0.08 |
| RIVERSDALE | 113 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000045 | 0.49 | 3905.89 | 2652.29 | 0.08 |
| RIVERSDALE | 113 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000045 | 0.49 | 3906.19 | 2652.31 | 0.08 |
| RIVERSDALE | 112 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.69 | | 273.70 | 0.000129 | 0.61 | 434.24 | 926.28 | 0.12 |
| RIVERSDALE | 112 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.69 | | 273.70 | 0.000129 | 0.61 | 434.24 | 926.28 | 0.12 |
| RIVERSDALE | 112 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.69 | | 273.70 | 0.000129 | 0.61 | 434.24 | 926.28 | 0.12 |
| RIVERSDALE | 112 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.85 | | 273.86 | 0.000113 | 0.59 | 588.13 | 1002.33 | 0.11 |
| RIVERSDALE | 112 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.85 | | 273.86 | 0.000113 | 0.59 | 588.13 | 1002.33 | 0.11 |
| RIVERSDALE | 112 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.85 | | 273.86 | 0.000113 | 0.59 | 588.13 | 1002.33 | 0.11 |
| RIVERSDALE | 112 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.97 | | 273.98 | 0.000102 | 0.58 | 713.10 | 1060.02 | 0.11 |
| RIVERSDALE | 112 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.97 | | 273.98 | 0.000102 | 0.58 | 713.10 | 1060.02 | 0.11 |
| RIVERSDALE | 112 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.97 | | 273.98 | 0.000102 | 0.58 | 713.10 | 1060.02 | 0.11 |
| RIVERSDALE | 112 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.10 | | 274.11 | 0.000108 | 0.61 | 962.74 | 2382.39 | 0.11 |
| RIVERSDALE | 112 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.10 | | 274.11 | 0.000108 | 0.61 | 962.74 | 2382.39 | 0.11 |
| RIVERSDALE | 112 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.10 | | 274.11 | 0.000108 | 0.61 | 962.74 | 2382.39 | 0.11 |
| RIVERSDALE | 112 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 111 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.68 | | 273.69 | 0.000107 | 0.57 | 351.38 | 511.97 | 0.11 |
| RIVERSDALE | 111 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.68 | | 273.69 | 0.000107 | 0.57 | 351.38 | 511.97 | 0.11 |
| RIVERSDALE | 111 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.68 | | 273.69 | 0.000107 | 0.57 | 351.38 | 511.97 | 0.11 |
| RIVERSDALE | 111 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.84 | | 273.85 | 0.000116 | 0.61 | 453.80 | 789.37 | 0.12 |
| RIVERSDALE | 111 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.84 | | 273.85 | 0.000116 | 0.61 | 453.80 | 789.37 | 0.12 |
| RIVERSDALE | 111 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.84 | | 273.85 | 0.000116 | 0.61 | 453.80 | 789.37 | 0.12 |
| RIVERSDALE | 111 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.96 | | 273.97 | 0.000118 | 0.64 | 556.72 | 918.90 | 0.12 |
| RIVERSDALE | 111 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.96 | | 273.97 | 0.000118 | 0.64 | 556.72 | 918.90 | 0.12 |
| RIVERSDALE | 111 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.96 | | 273.97 | 0.000118 | 0.64 | 556.72 | 918.90 | 0.12 |
| RIVERSDALE | 111 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.08 | | 274.10 | 0.000168 | 0.78 | 771.81 | 2218.67 | 0.14 |
| RIVERSDALE | 111 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.08 | | 274.10 | 0.000168 | 0.78 | 771.81 | 2218.67 | 0.14 |
| RIVERSDALE | 111 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.08 | | 274.10 | 0.000168 | 0.78 | 771.81 | 2218.67 | 0.14 |
| RIVERSDALE | 111 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 111 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 111 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 110 | 10-YR | EX-OFAT | 103.70 | 270.86 | 273.68 | | 273.68 | 0.000064 | 0.44 | 481.68 | 534.61 | 0.09 |
| RIVERSDALE | 110 | 10-YR | PR-OFAT | 103.70 | 270.86 | 273.68 | | 273.68 | 0.000064 | 0.44 | 481.68 | 534.61 | 0.09 |
| RIVERSDALE | 110 | 10-YR | PR 2-OFAT | 103.70 | 270.86 | 273.68 | | 273.68 | 0.000064 | 0.44 | 481.68 | 534.61 | 0.09 |
| RIVERSDALE | 110 | 25-YR | EX-OFAT | 129.50 | 270.86 | 273.84 | | 273.84 | 0.000065 | 0.46 | 567.63 | 586.60 | 0.09 |
| RIVERSDALE | 110 | 25-YR | PR-OFAT | 129.50 | 270.86 | 273.84 | | 273.84 | 0.000065 | 0.46 | 567.63 | 586.60 | 0.09 |
| RIVERSDALE | 110 | 25-YR | PR 2-OFAT | 129.50 | 270.86 | 273.84 | | 273.84 | 0.000065 | 0.46 | 567.63 | 586.60 | 0.09 |
| RIVERSDALE | 110 | 50-YR | EX-OFAT | 152.40 | 270.86 | 273.96 | | 273.96 | 0.000066 | 0.48 | 645.68 | 713.12 | 0.09 |
| RIVERSDALE | 110 | 50-YR | PR-OFAT | 152.40 | 270.86 | 273.96 | | 273.96 | 0.000066 | 0.48 | 645.68 | 713.12 | 0.09 |
| RIVERSDALE | 110 | 50-YR | PR 2-OFAT | 152.40 | 270.86 | 273.96 | | 273.96 | 0.000066 | 0.48 | 645.68 | 713.12 | 0.09 |
| RIVERSDALE | 110 | 100-YR | EX-OFAT | 175.70 | 270.86 | 274.07 | | 274.08 | 0.000122 | 0.67 | 827.26 | 2048.46 | 0.12 |
| RIVERSDALE | 110 | 100-YR | PR-OFAT | 175.70 | 270.86 | 274.07 | | 274.08 | 0.000122 | 0.67 | 827.26 | 2048.46 | 0.12 |
| RIVERSDALE | 110 | 100-YR | PR 2-OFAT | 175.70 | 270.86 | 274.07 | | 274.08 | 0.000122 | 0.67 | 827.26 | 2048.46 | 0.12 |
| RIVERSDALE | 110 | REGIONAL | EX-OFAT | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | PR-OFAT | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | PR 2-OFAT | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 109 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.66 | | 273.67 | 0.000126 | 0.62 | 298.04 | 247.85 | 0.12 |
| RIVERSDALE | 109 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.66 | | 273.67 | 0.000126 | 0.62 | 298.04 | 247.85 | 0.12 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|-----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 109 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.66 | | 273.67 | 0.000126 | 0.62 | 298.04 | 247.85 | 0.12 |
| RIVERSDALE | 109 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.81 | | 273.83 | 0.000150 | 0.70 | 337.80 | 272.48 | 0.13 |
| RIVERSDALE | 109 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.81 | | 273.83 | 0.000150 | 0.70 | 337.80 | 272.48 | 0.13 |
| RIVERSDALE | 109 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.81 | | 273.83 | 0.000150 | 0.70 | 337.80 | 272.48 | 0.13 |
| RIVERSDALE | 109 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.93 | | 273.95 | 0.000170 | 0.76 | 370.79 | 293.28 | 0.14 |
| RIVERSDALE | 109 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.93 | | 273.95 | 0.000170 | 0.76 | 370.79 | 293.28 | 0.14 |
| RIVERSDALE | 109 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.93 | | 273.95 | 0.000170 | 0.76 | 370.79 | 293.28 | 0.14 |
| RIVERSDALE | 109 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.02 | | 274.06 | 0.000297 | 1.03 | 437.72 | 2181.06 | 0.19 |
| RIVERSDALE | 109 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.02 | | 274.06 | 0.000297 | 1.03 | 437.72 | 2181.06 | 0.19 |
| RIVERSDALE | 109 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.02 | | 274.06 | 0.000297 | 1.03 | 437.72 | 2181.06 | 0.19 |
| RIVERSDALE | 109 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 108 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.63 | | 273.66 | 0.000309 | 0.95 | 279.05 | 293.34 | 0.19 |
| RIVERSDALE | 108 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.63 | | 273.66 | 0.000309 | 0.95 | 279.05 | 293.34 | 0.19 |
| RIVERSDALE | 108 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.63 | | 273.66 | 0.000309 | 0.95 | 279.05 | 293.34 | 0.19 |
| RIVERSDALE | 108 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.78 | | 273.81 | 0.000344 | 1.04 | 324.72 | 315.15 | 0.20 |
| RIVERSDALE | 108 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.78 | | 273.81 | 0.000344 | 1.04 | 324.72 | 315.15 | 0.20 |
| RIVERSDALE | 108 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.78 | | 273.81 | 0.000344 | 1.04 | 324.72 | 315.15 | 0.20 |
| RIVERSDALE | 108 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.90 | | 273.93 | 0.000371 | 1.11 | 362.03 | 334.01 | 0.21 |
| RIVERSDALE | 108 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.90 | | 273.93 | 0.000371 | 1.11 | 362.03 | 334.01 | 0.21 |
| RIVERSDALE | 108 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.90 | | 273.93 | 0.000371 | 1.11 | 362.03 | 334.01 | 0.21 |
| RIVERSDALE | 108 | 100-YR | EX-OFAT | 175.70 | 271.00 | 274.00 | | 274.04 | 0.000398 | 1.18 | 397.60 | 357.79 | 0.22 |
| RIVERSDALE | 108 | 100-YR | PR-OFAT | 175.70 | 271.00 | 274.00 | | 274.04 | 0.000398 | 1.18 | 397.60 | 357.79 | 0.22 |
| RIVERSDALE | 108 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 274.00 | | 274.04 | 0.000398 | 1.18 | 397.60 | 357.79 | 0.22 |
| RIVERSDALE | 108 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.15 | 3556.31 | 0.11 |
| RIVERSDALE | 108 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.15 | 3556.31 | 0.11 |
| RIVERSDALE | 108 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.15 | 3556.31 | 0.11 |
| RIVERSDALE | 107 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.61 | | 273.65 | 0.000356 | 1.00 | 279.94 | 316.70 | 0.20 |
| RIVERSDALE | 107 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.61 | | 273.65 | 0.000356 | 1.00 | 279.94 | 316.70 | 0.20 |
| RIVERSDALE | 107 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.61 | | 273.65 | 0.000356 | 1.00 | 279.94 | 316.70 | 0.20 |
| RIVERSDALE | 107 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.76 | | 273.80 | 0.000391 | 1.09 | 329.91 | 351.39 | 0.21 |
| RIVERSDALE | 107 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.76 | | 273.80 | 0.000391 | 1.09 | 329.91 | 351.39 | 0.21 |
| RIVERSDALE | 107 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.76 | | 273.80 | 0.000391 | 1.09 | 329.91 | 351.39 | 0.21 |
| RIVERSDALE | 107 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.88 | | 273.92 | 0.000414 | 1.15 | 371.64 | 373.34 | 0.22 |
| RIVERSDALE | 107 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.88 | | 273.92 | 0.000414 | 1.15 | 371.64 | 373.34 | 0.22 |
| RIVERSDALE | 107 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.88 | | 273.92 | 0.000414 | 1.15 | 371.64 | 373.34 | 0.22 |
| RIVERSDALE | 107 | 100-YR | EX-OFAT | 175.70 | 271.00 | 273.98 | | 274.02 | 0.000445 | 1.22 | 412.61 | 425.91 | 0.23 |
| RIVERSDALE | 107 | 100-YR | PR-OFAT | 175.70 | 271.00 | 273.98 | | 274.02 | 0.000445 | 1.22 | 412.61 | 425.91 | 0.23 |
| RIVERSDALE | 107 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 273.98 | | 274.02 | 0.000445 | 1.22 | 412.61 | 425.91 | 0.23 |
| RIVERSDALE | 107 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.68 | 3540.60 | 0.13 |
| RIVERSDALE | 107 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.68 | 3540.60 | 0.13 |
| RIVERSDALE | 107 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.68 | 3540.60 | 0.13 |
| RIVERSDALE | 106 | 10-YR | EX-OFAT | 103.70 | 270.01 | 273.58 | | 273.60 | 0.000188 | 0.83 | 295.52 | 346.49 | 0.15 |
| RIVERSDALE | 106 | 10-YR | PR-OFAT | 103.70 | 270.01 | 273.58 | | 273.60 | 0.000188 | 0.83 | 295.52 | 346.49 | 0.15 |
| RIVERSDALE | 106 | 10-YR | PR 2-OFAT | 103.70 | 270.01 | 273.58 | | 273.60 | 0.000188 | 0.83 | 295.52 | 346.49 | 0.15 |
| RIVERSDALE | 106 | 25-YR | EX-OFAT | 129.50 | 270.01 | 273.73 | | 273.75 | 0.000209 | 0.90 | 349.23 | 388.52 | 0.16 |
| RIVERSDALE | 106 | 25-YR | PR-OFAT | 129.50 | 270.01 | 273.73 | | 273.75 | 0.000209 | 0.90 | 349.23 | 388.52 | 0.16 |
| RIVERSDALE | 106 | 25-YR | PR 2-OFAT | 129.50 | 270.01 | 273.73 | | 273.75 | 0.000209 | 0.90 | 349.23 | 388.52 | 0.16 |
| RIVERSDALE | 106 | 50-YR | EX-OFAT | 152.40 | 270.01 | 273.84 | | 273.87 | 0.000223 | 0.95 | 395.13 | 421.79 | 0.17 |
| RIVERSDALE | 106 | 50-YR | PR-OFAT | 152.40 | 270.01 | 273.84 | | 273.87 | 0.000223 | 0.95 | 395.13 | 421.79 | 0.17 |
| RIVERSDALE | 106 | 50-YR | PR 2-OFAT | 152.40 | 270.01 | 273.84 | | 273.87 | 0.000223 | 0.95 | 395.13 | 421.79 | 0.17 |
| RIVERSDALE | 106 | 100-YR | EX-OFAT | 175.70 | 270.01 | 273.94 | | 273.97 | 0.000237 | 1.00 | 439.49 | 453.78 | 0.17 |
| RIVERSDALE | 106 | 100-YR | PR-OFAT | 175.70 | 270.01 | 273.94 | | 273.97 | 0.000237 | 1.00 | 439.49 | 453.78 | 0.17 |
| RIVERSDALE | 106 | 100-YR | PR 2-OFAT | 175.70 | 270.01 | 273.94 | | 273.97 | 0.000237 | 1.00 | 439.49 | 453.78 | 0.17 |
| RIVERSDALE | 106 | REGIONAL | EX-OFAT | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.06 | 3631.21 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | PR-OFAT | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.06 | 3631.21 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | PR 2-OFAT | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.06 | 3631.21 | 0.15 |
| RIVERSDALE | 105 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.56 | | 273.57 | 0.000146 | 0.64 | 462.03 | 285.80 | 0.13 |
| RIVERSDALE | 105 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.56 | | 273.57 | 0.000146 | 0.64 | 462.03 | 285.80 | 0.13 |
| RIVERSDALE | 105 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.56 | | 273.57 | 0.000146 | 0.64 | 462.03 | 285.80 | 0.13 |
| RIVERSDALE | 105 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.70 | | 273.71 | 0.000184 | 0.75 | 503.10 | 302.87 | 0.15 |
| RIVERSDALE | 105 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.70 | | 273.71 | 0.000184 | 0.75 | 503.10 | 302.87 | 0.15 |
| RIVERSDALE | 105 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.70 | | 273.71 | 0.000184 | 0.75 | 503.10 | 302.87 | 0.15 |
| RIVERSDALE | 105 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.80 | | 273.82 | 0.000222 | 0.84 | 536.52 | 321.45 | 0.16 |
| RIVERSDALE | 105 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.80 | | 273.82 | 0.000222 | 0.84 | 536.52 | 321.45 | 0.16 |
| RIVERSDALE | 105 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.80 | | 273.82 | 0.000222 | 0.84 | 536.52 | 321.45 | 0.16 |
| RIVERSDALE | 105 | 100-YR | EX-OFAT | 175.70 | 271.00 | 273.90 | | 273.92 | 0.000258 | 0.93 | 567.74 | 334.84 | 0.17 |
| RIVERSDALE | 105 | 100-YR | PR-OFAT | 175.70 | 271.00 | 273.90 | | 273.92 | 0.000258 | 0.93 | 567.74 | 334.84 | 0.17 |
| RIVERSDALE | 105 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 273.90 | | 273.92 | 0.000258 | 0.93 | 567.74 | 334.84 | 0.17 |
| RIVERSDALE | 105 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 274.99 | | 275.04 | 0.000698 | 1.89 | 1346.90 | 1199.05 | 0.30 |
| RIVERSDALE | 105 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 274.99 | | 275.04 | 0.000698 | 1.89 | 1346.90 | 1199.05 | 0.30 |
| RIVERSDALE | 105 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 274.99 | | 275.04 | 0.000698 | 1.89 | 1346.90 | 1199.05 | 0.30 |
| RIVERSDALE | 104 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.52 | | 273.54 | 0.000227 | 0.79 | 287.08 | 273.64 | 0.16 |
| RIVERSDALE | 104 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.52 | | 273.54 | 0.000227 | 0.79 | 287.08 | 273.64 | 0.16 |
| RIVERSDALE | 104 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.52 | | 273.54 | 0.000227 | 0.79 | 287.08 | 273.64 | 0.16 |
| RIVERSDALE | 104 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.66 | | 273.68 | 0.000261 | 0.88 | 325.17 | 293.83 | 0.17 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W S. Elev (m) | Crit W S. (m) | E G Elev (m) | E G Slope (m/m) | Vei Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|-----------|-------------------|------------------|------------------|------------------|-----------------|--------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 104 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.66 | | 273.68 | 0.000261 | 0.88 | 325.17 | 293.83 | 0.17 |
| RIVERSDALE | 104 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.66 | | 273.68 | 0.000261 | 0.88 | 325.17 | 293.83 | 0.17 |
| RIVERSDALE | 104 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.76 | | 273.78 | 0.000288 | 0.95 | 356.04 | 308.65 | 0.18 |
| RIVERSDALE | 104 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.76 | | 273.78 | 0.000288 | 0.95 | 356.04 | 308.65 | 0.18 |
| RIVERSDALE | 104 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.76 | | 273.78 | 0.000288 | 0.95 | 356.04 | 308.65 | 0.18 |
| RIVERSDALE | 104 | 100-YR | EX-OFAT | 175.70 | 271.00 | 273.85 | | 273.87 | 0.000315 | 1.01 | 384.75 | 322.29 | 0.19 |
| RIVERSDALE | 104 | 100-YR | PR-OFAT | 175.70 | 271.00 | 273.85 | | 273.87 | 0.000315 | 1.01 | 384.75 | 322.29 | 0.19 |
| RIVERSDALE | 104 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 273.85 | | 273.87 | 0.000315 | 1.01 | 384.75 | 322.29 | 0.19 |
| RIVERSDALE | 104 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.70 | 907.04 | 0.30 |
| RIVERSDALE | 104 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.70 | 907.04 | 0.30 |
| RIVERSDALE | 104 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.70 | 907.04 | 0.30 |
| RIVERSDALE | 103 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.48 | | 273.50 | 0.000246 | 0.81 | 281.33 | 256.91 | 0.17 |
| RIVERSDALE | 103 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.48 | | 273.50 | 0.000246 | 0.81 | 281.33 | 256.91 | 0.17 |
| RIVERSDALE | 103 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.48 | | 273.50 | 0.000246 | 0.81 | 281.33 | 256.91 | 0.17 |
| RIVERSDALE | 103 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.60 | | 273.63 | 0.000290 | 0.91 | 314.40 | 267.98 | 0.18 |
| RIVERSDALE | 103 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.60 | | 273.63 | 0.000290 | 0.91 | 314.40 | 267.98 | 0.18 |
| RIVERSDALE | 103 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.60 | | 273.63 | 0.000290 | 0.91 | 314.40 | 267.98 | 0.18 |
| RIVERSDALE | 103 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.70 | | 273.72 | 0.000328 | 0.99 | 340.37 | 275.64 | 0.19 |
| RIVERSDALE | 103 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.70 | | 273.72 | 0.000328 | 0.99 | 340.37 | 275.64 | 0.19 |
| RIVERSDALE | 103 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.70 | | 273.72 | 0.000328 | 0.99 | 340.37 | 275.64 | 0.19 |
| RIVERSDALE | 103 | 100-YR | EX-OFAT | 175.70 | 271.00 | 273.78 | | 273.81 | 0.000368 | 1.07 | 363.81 | 282.86 | 0.21 |
| RIVERSDALE | 103 | 100-YR | PR-OFAT | 175.70 | 271.00 | 273.78 | | 273.81 | 0.000368 | 1.07 | 363.81 | 282.86 | 0.21 |
| RIVERSDALE | 103 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 273.78 | | 273.81 | 0.000368 | 1.07 | 363.81 | 282.86 | 0.21 |
| RIVERSDALE | 103 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.93 | 832.33 | 0.34 |
| RIVERSDALE | 103 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.93 | 832.33 | 0.34 |
| RIVERSDALE | 103 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.93 | 832.33 | 0.34 |
| RIVERSDALE | 102 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.44 | | 273.46 | 0.000285 | 0.87 | 337.95 | 382.54 | 0.18 |
| RIVERSDALE | 102 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.44 | | 273.46 | 0.000285 | 0.87 | 337.95 | 382.54 | 0.18 |
| RIVERSDALE | 102 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.44 | | 273.46 | 0.000285 | 0.87 | 337.95 | 382.54 | 0.18 |
| RIVERSDALE | 102 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.56 | | 273.58 | 0.000327 | 0.96 | 386.65 | 421.44 | 0.19 |
| RIVERSDALE | 102 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.56 | | 273.58 | 0.000327 | 0.96 | 386.65 | 421.44 | 0.19 |
| RIVERSDALE | 102 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.56 | | 273.58 | 0.000327 | 0.96 | 386.65 | 421.44 | 0.19 |
| RIVERSDALE | 102 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.65 | | 273.68 | 0.000361 | 1.04 | 426.53 | 449.53 | 0.20 |
| RIVERSDALE | 102 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.65 | | 273.68 | 0.000361 | 1.04 | 426.53 | 449.53 | 0.20 |
| RIVERSDALE | 102 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.65 | | 273.68 | 0.000361 | 1.04 | 426.53 | 449.53 | 0.20 |
| RIVERSDALE | 102 | 100-YR | EX-OFAT | 175.70 | 271.00 | 273.73 | | 273.76 | 0.000395 | 1.10 | 463.34 | 473.75 | 0.21 |
| RIVERSDALE | 102 | 100-YR | PR-OFAT | 175.70 | 271.00 | 273.73 | | 273.76 | 0.000395 | 1.10 | 463.34 | 473.75 | 0.21 |
| RIVERSDALE | 102 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 273.73 | | 273.76 | 0.000395 | 1.10 | 463.34 | 473.75 | 0.21 |
| RIVERSDALE | 102 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.61 | 1114.24 | 0.27 |
| RIVERSDALE | 102 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.61 | 1114.24 | 0.27 |
| RIVERSDALE | 102 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.61 | 1114.24 | 0.27 |
| RIVERSDALE | 101 | 10-YR | EX-OFAT | 103.70 | 271.97 | 273.37 | | 273.38 | 0.000421 | 0.73 | 334.25 | 642.76 | 0.20 |
| RIVERSDALE | 101 | 10-YR | PR-OFAT | 103.70 | 271.97 | 273.37 | | 273.38 | 0.000421 | 0.73 | 334.25 | 642.76 | 0.20 |
| RIVERSDALE | 101 | 10-YR | PR 2-OFAT | 103.70 | 271.97 | 273.37 | | 273.38 | 0.000421 | 0.73 | 334.25 | 642.76 | 0.20 |
| RIVERSDALE | 101 | 25-YR | EX-OFAT | 129.50 | 271.97 | 273.49 | | 273.50 | 0.000384 | 0.74 | 416.59 | 715.79 | 0.19 |
| RIVERSDALE | 101 | 25-YR | PR-OFAT | 129.50 | 271.97 | 273.49 | | 273.50 | 0.000384 | 0.74 | 416.59 | 715.79 | 0.19 |
| RIVERSDALE | 101 | 25-YR | PR 2-OFAT | 129.50 | 271.97 | 273.49 | | 273.50 | 0.000384 | 0.74 | 416.59 | 715.79 | 0.19 |
| RIVERSDALE | 101 | 50-YR | EX-OFAT | 152.40 | 271.97 | 273.59 | | 273.60 | 0.000367 | 0.75 | 484.22 | 770.61 | 0.19 |
| RIVERSDALE | 101 | 50-YR | PR-OFAT | 152.40 | 271.97 | 273.59 | | 273.60 | 0.000367 | 0.75 | 484.22 | 770.61 | 0.19 |
| RIVERSDALE | 101 | 50-YR | PR 2-OFAT | 152.40 | 271.97 | 273.59 | | 273.60 | 0.000367 | 0.75 | 484.22 | 770.61 | 0.19 |
| RIVERSDALE | 101 | 100-YR | EX-OFAT | 175.70 | 271.97 | 273.66 | | 273.67 | 0.000362 | 0.77 | 546.37 | 817.63 | 0.19 |
| RIVERSDALE | 101 | 100-YR | PR-OFAT | 175.70 | 271.97 | 273.66 | | 273.67 | 0.000362 | 0.77 | 546.37 | 817.63 | 0.19 |
| RIVERSDALE | 101 | 100-YR | PR 2-OFAT | 175.70 | 271.97 | 273.66 | | 273.67 | 0.000362 | 0.77 | 546.37 | 817.63 | 0.19 |
| RIVERSDALE | 101 | REGIONAL | EX-OFAT | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000463 | 1.15 | 1474.91 | 1229.20 | 0.23 |
| RIVERSDALE | 101 | REGIONAL | PR-OFAT | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000463 | 1.15 | 1474.91 | 1229.20 | 0.23 |
| RIVERSDALE | 101 | REGIONAL | PR 2-OFAT | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000463 | 1.15 | 1474.91 | 1229.20 | 0.23 |
| RIVERSDALE | 100 | 10-YR | EX-OFAT | 103.70 | 271.00 | 273.24 | 272.46 | 273.31 | 0.001000 | 1.45 | 219.22 | 470.56 | 0.32 |
| RIVERSDALE | 100 | 10-YR | PR-OFAT | 103.70 | 271.00 | 273.24 | 272.46 | 273.31 | 0.001000 | 1.45 | 219.22 | 470.56 | 0.32 |
| RIVERSDALE | 100 | 10-YR | PR 2-OFAT | 103.70 | 271.00 | 273.24 | 272.46 | 273.31 | 0.001000 | 1.45 | 219.22 | 470.56 | 0.32 |
| RIVERSDALE | 100 | 25-YR | EX-OFAT | 129.50 | 271.00 | 273.36 | 272.61 | 273.43 | 0.001000 | 1.51 | 282.64 | 531.68 | 0.33 |
| RIVERSDALE | 100 | 25-YR | PR-OFAT | 129.50 | 271.00 | 273.36 | 272.61 | 273.43 | 0.001000 | 1.51 | 282.64 | 531.68 | 0.33 |
| RIVERSDALE | 100 | 25-YR | PR 2-OFAT | 129.50 | 271.00 | 273.36 | 272.61 | 273.43 | 0.001000 | 1.51 | 282.64 | 531.68 | 0.33 |
| RIVERSDALE | 100 | 50-YR | EX-OFAT | 152.40 | 271.00 | 273.46 | 272.73 | 273.52 | 0.001001 | 1.56 | 336.59 | 609.52 | 0.33 |
| RIVERSDALE | 100 | 50-YR | PR-OFAT | 152.40 | 271.00 | 273.46 | 272.73 | 273.52 | 0.001001 | 1.56 | 336.59 | 609.52 | 0.33 |
| RIVERSDALE | 100 | 50-YR | PR 2-OFAT | 152.40 | 271.00 | 273.46 | 272.73 | 273.52 | 0.001001 | 1.56 | 336.59 | 609.52 | 0.33 |
| RIVERSDALE | 100 | 100-YR | EX-OFAT | 175.70 | 271.00 | 273.54 | 272.84 | 273.60 | 0.001001 | 1.60 | 388.44 | 670.95 | 0.33 |
| RIVERSDALE | 100 | 100-YR | PR-OFAT | 175.70 | 271.00 | 273.54 | 272.84 | 273.60 | 0.001001 | 1.60 | 388.44 | 670.95 | 0.33 |
| RIVERSDALE | 100 | 100-YR | PR 2-OFAT | 175.70 | 271.00 | 273.54 | 272.84 | 273.60 | 0.001001 | 1.60 | 388.44 | 670.95 | 0.33 |
| RIVERSDALE | 100 | REGIONAL | EX-OFAT | 734.50 | 271.00 | 274.44 | 273.89 | 274.49 | 0.001001 | 1.98 | 1370.35 | 1425.35 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | PR-OFAT | 734.50 | 271.00 | 274.44 | 273.89 | 274.49 | 0.001001 | 1.98 | 1370.35 | 1425.35 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | PR 2-OFAT | 734.50 | 271.00 | 274.44 | 273.89 | 274.49 | 0.001001 | 1.98 | 1370.35 | 1425.35 | 0.35 |

MIDUSS FLOWS

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W S Elev (m) | Crit W S (m) | E G Elev (m) | E G Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Ch |
|------------|-----------|----------|----------|-------------------|------------------|-----------------|-----------------|-----------------|--------------------|-------------------|-------------------|------------------|-------------|
| RIVERSDALE | 124 | 10-YR | EX-MDS | 295 10 | 271.01 | 275.16 | | 275.17 | 0.000069 | 0.59 | 1159.02 | 621.86 | 0.09 |
| RIVERSDALE | 124 | 10-YR | PR-MDS | 295 10 | 271.01 | 275.17 | | 275.17 | 0.000068 | 0.58 | 1160.36 | 622.20 | 0.09 |
| RIVERSDALE | 124 | 10-YR | PR 2-MDS | 295 10 | 271.01 | 275.17 | | 275.17 | 0.000068 | 0.58 | 1161.48 | 622.49 | 0.09 |
| RIVERSDALE | 124 | 25-YR | EX-MDS | 357 90 | 271.01 | 275.54 | | 275.54 | 0.000059 | 0.58 | 1402.88 | 876.03 | 0.09 |
| RIVERSDALE | 124 | 25-YR | PR-MDS | 357 90 | 271.01 | 275.54 | | 275.54 | 0.000059 | 0.58 | 1401.86 | 875.84 | 0.09 |
| RIVERSDALE | 124 | 25-YR | PR 2-MDS | 357 90 | 271.01 | 275.54 | | 275.54 | 0.000059 | 0.58 | 1401.03 | 875.67 | 0.09 |
| RIVERSDALE | 124 | 50-YR | EX-MDS | 407 00 | 271.01 | 275.96 | | 275.96 | 0.000043 | 0.53 | 1697.66 | 764.82 | 0.08 |
| RIVERSDALE | 124 | 50-YR | PR-MDS | 407 00 | 271.01 | 275.96 | | 275.96 | 0.000043 | 0.53 | 1697.66 | 764.82 | 0.08 |
| RIVERSDALE | 124 | 50-YR | PR 2-MDS | 407 00 | 271.01 | 275.96 | | 275.96 | 0.000043 | 0.53 | 1697.66 | 764.82 | 0.08 |
| RIVERSDALE | 124 | 100-YR | EX-MDS | 458 50 | 271.01 | 275.74 | | 275.75 | 0.000073 | 0.66 | 1542.65 | 693.89 | 0.10 |
| RIVERSDALE | 124 | 100-YR | PR-MDS | 458 50 | 271.01 | 275.74 | | 275.75 | 0.000073 | 0.66 | 1542.65 | 693.89 | 0.10 |
| RIVERSDALE | 124 | 100-YR | PR 2-MDS | 458 50 | 271.01 | 275.74 | | 275.75 | 0.000073 | 0.66 | 1542.65 | 693.89 | 0.10 |
| RIVERSDALE | 124 | REGIONAL | EX-MDS | 734 50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 124 | REGIONAL | PR-MDS | 734 50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 124 | REGIONAL | PR 2-MDS | 734 50 | 271.01 | 275.99 | | 276.01 | 0.000134 | 0.93 | 1727.69 | 776.24 | 0.14 |
| RIVERSDALE | 123 | 10-YR | EX-MDS | 295 10 | 271.00 | 275.16 | | 275.16 | 0.000040 | 0.45 | 1587.42 | 865.16 | 0.07 |
| RIVERSDALE | 123 | 10-YR | PR-MDS | 295 10 | 271.00 | 275.16 | | 275.16 | 0.000040 | 0.45 | 1589.32 | 865.23 | 0.07 |
| RIVERSDALE | 123 | 10-YR | PR 2-MDS | 295 10 | 271.00 | 275.16 | | 275.17 | 0.000040 | 0.45 | 1590.88 | 865.29 | 0.07 |
| RIVERSDALE | 123 | 25-YR | EX-MDS | 357 90 | 271.00 | 275.54 | | 275.54 | 0.000032 | 0.43 | 1930.41 | 985.15 | 0.07 |
| RIVERSDALE | 123 | 25-YR | PR-MDS | 357 90 | 271.00 | 275.53 | | 275.54 | 0.000033 | 0.43 | 1928.93 | 984.70 | 0.07 |
| RIVERSDALE | 123 | 25-YR | PR 2-MDS | 357 90 | 271.00 | 275.53 | | 275.54 | 0.000033 | 0.43 | 1927.72 | 984.33 | 0.07 |
| RIVERSDALE | 123 | 50-YR | EX-MDS | 407 00 | 271.00 | 275.95 | | 275.96 | 0.000024 | 0.39 | 2372.46 | 1170.22 | 0.06 |
| RIVERSDALE | 123 | 50-YR | PR-MDS | 407 00 | 271.00 | 275.95 | | 275.96 | 0.000024 | 0.39 | 2372.46 | 1170.22 | 0.06 |
| RIVERSDALE | 123 | 50-YR | PR 2-MDS | 407 00 | 271.00 | 275.95 | | 275.96 | 0.000024 | 0.39 | 2372.46 | 1170.22 | 0.06 |
| RIVERSDALE | 123 | 100-YR | EX-MDS | 458 50 | 271.00 | 275.74 | | 275.74 | 0.000040 | 0.50 | 2137.36 | 1046.44 | 0.07 |
| RIVERSDALE | 123 | 100-YR | PR-MDS | 458 50 | 271.00 | 275.74 | | 275.74 | 0.000040 | 0.50 | 2137.36 | 1046.44 | 0.07 |
| RIVERSDALE | 123 | 100-YR | PR 2-MDS | 458 50 | 271.00 | 275.74 | | 275.74 | 0.000040 | 0.50 | 2137.36 | 1046.44 | 0.07 |
| RIVERSDALE | 123 | REGIONAL | EX-MDS | 734 50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 123 | REGIONAL | PR-MDS | 734 50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 123 | REGIONAL | PR 2-MDS | 734 50 | 271.00 | 275.99 | | 275.99 | 0.000073 | 0.70 | 2412.80 | 1178.96 | 0.10 |
| RIVERSDALE | 122 | 10-YR | EX-MDS | 295 10 | 271.81 | 275.15 | | 275.16 | 0.000077 | 0.55 | 1555.34 | 1128.13 | 0.10 |
| RIVERSDALE | 122 | 10-YR | PR-MDS | 295 10 | 271.81 | 275.16 | | 275.16 | 0.000077 | 0.55 | 1557.84 | 1128.50 | 0.10 |
| RIVERSDALE | 122 | 10-YR | PR 2-MDS | 295 10 | 271.81 | 275.16 | | 275.16 | 0.000076 | 0.55 | 1559.89 | 1128.79 | 0.10 |
| RIVERSDALE | 122 | 25-YR | EX-MDS | 357 90 | 271.81 | 275.53 | | 275.53 | 0.000056 | 0.51 | 1993.01 | 1191.16 | 0.08 |
| RIVERSDALE | 122 | 25-YR | PR-MDS | 357 90 | 271.81 | 275.53 | | 275.53 | 0.000056 | 0.51 | 1991.17 | 1190.95 | 0.08 |
| RIVERSDALE | 122 | 25-YR | PR 2-MDS | 357 90 | 271.81 | 275.53 | | 275.53 | 0.000056 | 0.51 | 1989.71 | 1190.78 | 0.08 |
| RIVERSDALE | 122 | 50-YR | EX-MDS | 407 00 | 271.81 | 275.95 | | 275.95 | 0.000036 | 0.44 | 2504.13 | 1247.41 | 0.07 |
| RIVERSDALE | 122 | 50-YR | PR-MDS | 407 00 | 271.81 | 275.95 | | 275.95 | 0.000036 | 0.44 | 2504.13 | 1247.41 | 0.07 |
| RIVERSDALE | 122 | 50-YR | PR 2-MDS | 407 00 | 271.81 | 275.95 | | 275.95 | 0.000036 | 0.44 | 2504.13 | 1247.41 | 0.07 |
| RIVERSDALE | 122 | 100-YR | EX-MDS | 458 50 | 271.81 | 275.73 | | 275.74 | 0.000065 | 0.57 | 2237.11 | 1218.06 | 0.09 |
| RIVERSDALE | 122 | 100-YR | PR-MDS | 458 50 | 271.81 | 275.73 | | 275.74 | 0.000065 | 0.57 | 2237.11 | 1218.06 | 0.09 |
| RIVERSDALE | 122 | 100-YR | PR 2-MDS | 458 50 | 271.81 | 275.73 | | 275.74 | 0.000065 | 0.57 | 2237.11 | 1218.06 | 0.09 |
| RIVERSDALE | 122 | REGIONAL | EX-MDS | 734 50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | PR-MDS | 734 50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 122 | REGIONAL | PR 2-MDS | 734 50 | 271.81 | 275.98 | | 275.99 | 0.000113 | 0.78 | 2540.99 | 1252.63 | 0.12 |
| RIVERSDALE | 121 | 10-YR | EX-MDS | 295 10 | 271.00 | 275.15 | | 275.15 | 0.000057 | 0.55 | 1602.73 | 1244.48 | 0.09 |
| RIVERSDALE | 121 | 10-YR | PR-MDS | 295 10 | 271.00 | 275.15 | | 275.16 | 0.000057 | 0.55 | 1605.51 | 1246.18 | 0.09 |
| RIVERSDALE | 121 | 10-YR | PR 2-MDS | 295 10 | 271.00 | 275.15 | | 275.16 | 0.000057 | 0.55 | 1607.81 | 1247.54 | 0.09 |
| RIVERSDALE | 121 | 25-YR | EX-MDS | 357 90 | 271.00 | 275.53 | | 275.53 | 0.000043 | 0.51 | 2088.27 | 1312.96 | 0.08 |
| RIVERSDALE | 121 | 25-YR | PR-MDS | 357 90 | 271.00 | 275.53 | | 275.53 | 0.000043 | 0.51 | 2086.25 | 1312.72 | 0.08 |
| RIVERSDALE | 121 | 25-YR | PR 2-MDS | 357 90 | 271.00 | 275.52 | | 275.53 | 0.000043 | 0.51 | 2084.63 | 1312.52 | 0.08 |
| RIVERSDALE | 121 | 50-YR | EX-MDS | 407 00 | 271.00 | 275.95 | | 275.95 | 0.000029 | 0.44 | 2655.88 | 1385.17 | 0.06 |
| RIVERSDALE | 121 | 50-YR | PR-MDS | 407 00 | 271.00 | 275.95 | | 275.95 | 0.000029 | 0.44 | 2655.88 | 1385.17 | 0.06 |
| RIVERSDALE | 121 | 50-YR | PR 2-MDS | 407 00 | 271.00 | 275.95 | | 275.95 | 0.000029 | 0.44 | 2655.88 | 1385.17 | 0.06 |
| RIVERSDALE | 121 | 100-YR | EX-MDS | 458 50 | 271.00 | 275.73 | | 275.73 | 0.000051 | 0.57 | 2356.89 | 1347.21 | 0.08 |
| RIVERSDALE | 121 | 100-YR | PR-MDS | 458 50 | 271.00 | 275.73 | | 275.73 | 0.000051 | 0.57 | 2356.89 | 1347.21 | 0.08 |
| RIVERSDALE | 121 | 100-YR | PR 2-MDS | 458 50 | 271.00 | 275.73 | | 275.73 | 0.000051 | 0.57 | 2356.89 | 1347.21 | 0.08 |
| RIVERSDALE | 121 | REGIONAL | EX-MDS | 734 50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 121 | REGIONAL | PR-MDS | 734 50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 121 | REGIONAL | PR 2-MDS | 734 50 | 271.00 | 275.97 | | 275.98 | 0.000091 | 0.79 | 2688.84 | 1389.48 | 0.11 |
| RIVERSDALE | 120 | 10-YR | EX-MDS | 295 10 | 271.01 | 274.53 | 273.81 | 275.09 | 0.003579 | 3.69 | 120.67 | 806.00 | 0.66 |
| RIVERSDALE | 120 | 10-YR | PR-MDS | 295 10 | 271.01 | 274.53 | 273.81 | 275.09 | 0.003563 | 3.68 | 120.85 | 806.45 | 0.66 |
| RIVERSDALE | 120 | 10-YR | PR 2-MDS | 295 10 | 271.01 | 274.54 | 273.81 | 275.09 | 0.003550 | 3.68 | 121.00 | 806.82 | 0.66 |
| RIVERSDALE | 120 | 25-YR | EX-MDS | 357 90 | 271.01 | 274.75 | 274.08 | 275.45 | 0.004160 | 4.15 | 130.22 | 831.84 | 0.72 |
| RIVERSDALE | 120 | 25-YR | PR-MDS | 357 90 | 271.01 | 274.74 | 274.08 | 275.45 | 0.004174 | 4.16 | 130.07 | 831.13 | 0.72 |
| RIVERSDALE | 120 | 25-YR | PR 2-MDS | 357 90 | 271.01 | 274.74 | 274.08 | 275.45 | 0.004185 | 4.16 | 129.96 | 830.57 | 0.72 |
| RIVERSDALE | 120 | 50-YR | EX-MDS | 407 00 | 271.01 | 275.93 | 275.35 | 275.95 | 0.000183 | 1.06 | 1437.15 | 1440.74 | 0.16 |
| RIVERSDALE | 120 | 50-YR | PR-MDS | 407 00 | 271.01 | 275.93 | 275.35 | 275.95 | 0.000183 | 1.06 | 1437.15 | 1440.74 | 0.16 |
| RIVERSDALE | 120 | 50-YR | PR 2-MDS | 407 00 | 271.01 | 275.93 | 275.35 | 275.95 | 0.000183 | 1.06 | 1437.15 | 1440.74 | 0.16 |
| RIVERSDALE | 120 | 100-YR | EX-MDS | 458 50 | 271.01 | 275.67 | 275.39 | 275.72 | 0.000513 | 1.71 | 1065.68 | 1420.12 | 0.26 |
| RIVERSDALE | 120 | 100-YR | PR-MDS | 458 50 | 271.01 | 275.67 | 275.39 | 275.72 | 0.000513 | 1.71 | 1065.68 | 1420.12 | 0.26 |
| RIVERSDALE | 120 | 100-YR | PR 2-MDS | 458 50 | 271.01 | 275.67 | 275.39 | 275.72 | 0.000513 | 1.71 | 1065.68 | 1420.12 | 0.26 |
| RIVERSDALE | 120 | REGIONAL | EX-MDS | 734 50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 120 | REGIONAL | PR-MDS | 734 50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 120 | REGIONAL | PR 2-MDS | 734 50 | 271.01 | 275.91 | 275.56 | 275.97 | 0.000635 | 1.97 | 1405.39 | 1438.77 | 0.30 |
| RIVERSDALE | 119.5 | | | Bridge | | | | | | | | | |
| RIVERSDALE | 119 | 10-YR | EX-MDS | 295 10 | 271.96 | 274.61 | | 274.64 | 0.000421 | 1.10 | 684.39 | 841.47 | 0.22 |
| RIVERSDALE | 119 | 10-YR | PR-MDS | 295 10 | 271.96 | 274.62 | | 274.64 | 0.000392 | 1.07 | 682.76 | 823.63 | 0.21 |
| RIVERSDALE | 119 | 10-YR | PR 2-MDS | 295 10 | 271.96 | 274.62 | | 274.65 | 0.000428 | 1.11 | 652.71 | 823.96 | 0.22 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 119 | 25-YR | EX-MDS | 357.90 | 271.96 | 274.75 | | 274.77 | 0.000423 | 1.14 | 798.20 | 978.13 | 0.22 |
| RIVERSDALE | 119 | 25-YR | PR-MDS | 357.90 | 271.96 | 274.75 | | 274.78 | 0.000396 | 1.11 | 800.63 | 964.59 | 0.21 |
| RIVERSDALE | 119 | 25-YR | PR 2-MDS | 357.90 | 271.96 | 274.75 | | 274.78 | 0.000431 | 1.16 | 765.21 | 965.95 | 0.22 |
| RIVERSDALE | 119 | 50-YR | EX-MDS | 407.00 | 271.96 | 274.84 | | 274.87 | 0.000427 | 1.18 | 892.89 | 1111.16 | 0.22 |
| RIVERSDALE | 119 | 50-YR | PR-MDS | 407.00 | 271.96 | 274.85 | | 274.87 | 0.000399 | 1.14 | 898.82 | 1119.30 | 0.22 |
| RIVERSDALE | 119 | 50-YR | PR 2-MDS | 407.00 | 271.96 | 274.85 | | 274.88 | 0.000436 | 1.19 | 859.19 | 1127.12 | 0.23 |
| RIVERSDALE | 119 | 100-YR | EX-MDS | 458.50 | 271.96 | 274.93 | | 274.95 | 0.000430 | 1.20 | 989.39 | 1248.17 | 0.23 |
| RIVERSDALE | 119 | 100-YR | PR-MDS | 458.50 | 271.96 | 274.93 | | 274.96 | 0.000401 | 1.16 | 998.50 | 1235.54 | 0.22 |
| RIVERSDALE | 119 | 100-YR | PR 2-MDS | 458.50 | 271.96 | 274.94 | | 274.96 | 0.000439 | 1.22 | 954.90 | 1236.79 | 0.23 |
| RIVERSDALE | 119 | REGIONAL | EX-MDS | 734.50 | 271.96 | 275.29 | | 275.32 | 0.000417 | 1.28 | 1490.01 | 1415.60 | 0.23 |
| RIVERSDALE | 119 | REGIONAL | PR-MDS | 734.50 | 271.96 | 275.30 | | 275.32 | 0.000390 | 1.24 | 1496.98 | 1401.23 | 0.22 |
| RIVERSDALE | 119 | REGIONAL | PR 2-MDS | 734.50 | 271.96 | 275.30 | | 275.33 | 0.000420 | 1.29 | 1451.57 | 1401.37 | 0.23 |
| RIVERSDALE | 118 | 10-YR | EX-MDS | 295.10 | 272.00 | 274.60 | | 274.62 | 0.000241 | 0.84 | 1069.71 | 1178.92 | 0.17 |
| RIVERSDALE | 118 | 10-YR | PR-MDS | 295.10 | 272.00 | 274.61 | | 274.62 | 0.000240 | 0.84 | 1039.33 | 1164.29 | 0.17 |
| RIVERSDALE | 118 | 10-YR | PR 2-MDS | 295.10 | 272.00 | 274.61 | | 274.62 | 0.000238 | 0.84 | 1042.73 | 1166.06 | 0.17 |
| RIVERSDALE | 118 | 25-YR | EX-MDS | 357.90 | 272.00 | 274.74 | | 274.75 | 0.000244 | 0.87 | 1232.50 | 1256.46 | 0.17 |
| RIVERSDALE | 118 | 25-YR | PR-MDS | 357.90 | 272.00 | 274.74 | | 274.76 | 0.000244 | 0.87 | 1200.36 | 1241.70 | 0.17 |
| RIVERSDALE | 118 | 25-YR | PR 2-MDS | 357.90 | 272.00 | 274.75 | | 274.76 | 0.000242 | 0.87 | 1203.90 | 1242.97 | 0.17 |
| RIVERSDALE | 118 | 50-YR | EX-MDS | 407.00 | 272.00 | 274.83 | | 274.85 | 0.000242 | 0.89 | 1356.92 | 1298.89 | 0.17 |
| RIVERSDALE | 118 | 50-YR | PR-MDS | 407.00 | 272.00 | 274.84 | | 274.85 | 0.000242 | 0.89 | 1323.04 | 1284.56 | 0.17 |
| RIVERSDALE | 118 | 50-YR | PR 2-MDS | 407.00 | 272.00 | 274.84 | | 274.86 | 0.000240 | 0.89 | 1326.72 | 1285.81 | 0.17 |
| RIVERSDALE | 118 | 100-YR | EX-MDS | 458.50 | 272.00 | 274.92 | | 274.93 | 0.000247 | 0.91 | 1467.95 | 1333.55 | 0.17 |
| RIVERSDALE | 118 | 100-YR | PR-MDS | 458.50 | 272.00 | 274.92 | | 274.94 | 0.000247 | 0.92 | 1432.55 | 1319.49 | 0.17 |
| RIVERSDALE | 118 | 100-YR | PR 2-MDS | 458.50 | 272.00 | 274.93 | | 274.94 | 0.000245 | 0.91 | 1436.21 | 1320.64 | 0.17 |
| RIVERSDALE | 118 | REGIONAL | EX-MDS | 734.50 | 272.00 | 275.28 | | 275.30 | 0.000276 | 1.05 | 1991.87 | 1483.27 | 0.18 |
| RIVERSDALE | 118 | REGIONAL | PR-MDS | 734.50 | 272.00 | 275.29 | | 275.30 | 0.000273 | 1.04 | 1951.36 | 1469.62 | 0.18 |
| RIVERSDALE | 118 | REGIONAL | PR 2-MDS | 734.50 | 272.00 | 275.29 | | 275.30 | 0.000271 | 1.04 | 1956.09 | 1469.96 | 0.18 |
| RIVERSDALE | 117 | 10-YR | EX-MDS | 295.10 | 272.00 | 274.58 | | 274.59 | 0.000274 | 0.89 | 740.63 | 970.72 | 0.18 |
| RIVERSDALE | 117 | 10-YR | PR-MDS | 295.10 | 272.00 | 274.58 | | 274.60 | 0.000285 | 0.91 | 713.07 | 956.86 | 0.18 |
| RIVERSDALE | 117 | 10-YR | PR 2-MDS | 295.10 | 272.00 | 274.59 | | 274.60 | 0.000290 | 0.91 | 715.38 | 958.62 | 0.18 |
| RIVERSDALE | 117 | 25-YR | EX-MDS | 357.90 | 272.00 | 274.71 | | 274.73 | 0.000276 | 0.92 | 877.87 | 1101.01 | 0.18 |
| RIVERSDALE | 117 | 25-YR | PR-MDS | 357.90 | 272.00 | 274.72 | | 274.73 | 0.000286 | 0.94 | 848.89 | 1087.39 | 0.18 |
| RIVERSDALE | 117 | 25-YR | PR 2-MDS | 357.90 | 272.00 | 274.72 | | 274.74 | 0.000292 | 0.95 | 851.44 | 1088.82 | 0.18 |
| RIVERSDALE | 117 | 50-YR | EX-MDS | 407.00 | 272.00 | 274.81 | | 274.83 | 0.000270 | 0.93 | 988.50 | 1158.03 | 0.18 |
| RIVERSDALE | 117 | 50-YR | PR-MDS | 407.00 | 272.00 | 274.82 | | 274.83 | 0.000279 | 0.95 | 958.03 | 1144.72 | 0.18 |
| RIVERSDALE | 117 | 50-YR | PR 2-MDS | 407.00 | 272.00 | 274.82 | | 274.83 | 0.000285 | 0.96 | 960.74 | 1146.08 | 0.18 |
| RIVERSDALE | 117 | 100-YR | EX-MDS | 458.50 | 272.00 | 274.89 | | 274.91 | 0.000272 | 0.95 | 1088.02 | 1207.42 | 0.18 |
| RIVERSDALE | 117 | 100-YR | PR-MDS | 458.50 | 272.00 | 274.90 | | 274.92 | 0.000281 | 0.97 | 1056.21 | 1194.62 | 0.18 |
| RIVERSDALE | 117 | 100-YR | PR 2-MDS | 458.50 | 272.00 | 274.90 | | 274.92 | 0.000287 | 0.98 | 1058.90 | 1196.01 | 0.18 |
| RIVERSDALE | 117 | REGIONAL | EX-MDS | 734.50 | 272.00 | 275.25 | | 275.27 | 0.000307 | 1.10 | 1604.75 | 1528.95 | 0.19 |
| RIVERSDALE | 117 | REGIONAL | PR-MDS | 734.50 | 272.00 | 275.26 | | 275.28 | 0.000316 | 1.11 | 1568.70 | 1515.95 | 0.20 |
| RIVERSDALE | 117 | REGIONAL | PR 2-MDS | 734.50 | 272.00 | 275.26 | | 275.28 | 0.000322 | 1.13 | 1572.82 | 1516.30 | 0.20 |
| RIVERSDALE | 116 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.51 | | 274.55 | 0.000577 | 1.51 | 587.06 | 616.86 | 0.27 |
| RIVERSDALE | 116 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.51 | | 274.55 | 0.000621 | 1.57 | 554.56 | 598.42 | 0.28 |
| RIVERSDALE | 116 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.51 | | 274.56 | 0.000626 | 1.57 | 555.48 | 599.11 | 0.28 |
| RIVERSDALE | 116 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.64 | | 274.66 | 0.000627 | 1.62 | 672.07 | 719.36 | 0.28 |
| RIVERSDALE | 116 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.63 | | 274.69 | 0.000675 | 1.68 | 637.01 | 700.85 | 0.29 |
| RIVERSDALE | 116 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.64 | | 274.69 | 0.000682 | 1.68 | 637.94 | 702.01 | 0.29 |
| RIVERSDALE | 116 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.73 | | 274.75 | 0.000646 | 1.67 | 745.74 | 801.67 | 0.29 |
| RIVERSDALE | 116 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.73 | | 274.78 | 0.000697 | 1.74 | 708.79 | 783.47 | 0.30 |
| RIVERSDALE | 116 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.73 | | 274.79 | 0.000703 | 1.74 | 709.75 | 784.60 | 0.30 |
| RIVERSDALE | 116 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.81 | | 274.88 | 0.000678 | 1.74 | 814.07 | 871.27 | 0.29 |
| RIVERSDALE | 116 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.81 | | 274.87 | 0.000731 | 1.81 | 775.29 | 853.62 | 0.30 |
| RIVERSDALE | 116 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.81 | | 274.87 | 0.000738 | 1.81 | 776.21 | 854.44 | 0.31 |
| RIVERSDALE | 116 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.17 | | 275.22 | 0.000766 | 1.97 | 1261.21 | 1513.76 | 0.32 |
| RIVERSDALE | 116 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.17 | | 275.22 | 0.000822 | 2.04 | 1215.62 | 1499.87 | 0.33 |
| RIVERSDALE | 116 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.17 | | 275.23 | 0.000826 | 2.04 | 1218.49 | 1500.17 | 0.33 |
| RIVERSDALE | 115 | 10-YR | EX-MDS | 295.10 | 270.07 | 274.48 | | 274.50 | 0.000221 | 1.10 | 969.21 | 1338.51 | 0.17 |
| RIVERSDALE | 115 | 10-YR | PR-MDS | 295.10 | 270.07 | 274.48 | | 274.50 | 0.000239 | 1.15 | 926.12 | 1320.12 | 0.18 |
| RIVERSDALE | 115 | 10-YR | PR 2-MDS | 295.10 | 270.07 | 274.48 | | 274.51 | 0.000237 | 1.14 | 928.82 | 1321.37 | 0.18 |
| RIVERSDALE | 115 | 25-YR | EX-MDS | 357.90 | 270.07 | 274.62 | | 274.63 | 0.000215 | 1.11 | 1150.88 | 1433.51 | 0.17 |
| RIVERSDALE | 115 | 25-YR | PR-MDS | 357.90 | 270.07 | 274.61 | | 274.63 | 0.000231 | 1.15 | 1106.06 | 1415.81 | 0.18 |
| RIVERSDALE | 115 | 25-YR | PR 2-MDS | 357.90 | 270.07 | 274.61 | | 274.63 | 0.000229 | 1.15 | 1108.64 | 1417.19 | 0.18 |
| RIVERSDALE | 115 | 50-YR | EX-MDS | 407.00 | 270.07 | 274.71 | | 274.73 | 0.000207 | 1.11 | 1297.29 | 1528.84 | 0.17 |
| RIVERSDALE | 115 | 50-YR | PR-MDS | 407.00 | 270.07 | 274.71 | | 274.73 | 0.000221 | 1.14 | 1251.08 | 1511.42 | 0.17 |
| RIVERSDALE | 115 | 50-YR | PR 2-MDS | 407.00 | 270.07 | 274.71 | | 274.73 | 0.000220 | 1.14 | 1253.64 | 1513.06 | 0.17 |
| RIVERSDALE | 115 | 100-YR | EX-MDS | 458.50 | 270.07 | 274.80 | | 274.81 | 0.000212 | 1.13 | 1426.26 | 1679.04 | 0.17 |
| RIVERSDALE | 115 | 100-YR | PR-MDS | 458.50 | 270.07 | 274.79 | | 274.81 | 0.000223 | 1.16 | 1378.73 | 1657.54 | 0.17 |
| RIVERSDALE | 115 | 100-YR | PR 2-MDS | 458.50 | 270.07 | 274.80 | | 274.81 | 0.000222 | 1.16 | 1381.30 | 1663.38 | 0.17 |
| RIVERSDALE | 115 | REGIONAL | EX-MDS | 734.50 | 270.07 | 275.15 | | 275.17 | 0.000225 | 1.23 | 2124.43 | 2171.07 | 0.18 |
| RIVERSDALE | 115 | REGIONAL | PR-MDS | 734.50 | 270.07 | 275.15 | | 275.16 | 0.000237 | 1.26 | 2070.07 | 2157.96 | 0.18 |
| RIVERSDALE | 115 | REGIONAL | PR 2-MDS | 734.50 | 270.07 | 275.15 | | 275.17 | 0.000236 | 1.26 | 2075.25 | 2158.33 | 0.18 |
| RIVERSDALE | 114 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.48 | 273.53 | 274.49 | 0.000068 | 0.53 | 1711.13 | 2068.56 | 0.09 |
| RIVERSDALE | 114 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.48 | | 274.49 | 0.000064 | 0.52 | 1751.00 | 2052.35 | 0.09 |
| RIVERSDALE | 114 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.48 | 273.55 | 274.49 | 0.000071 | 0.54 | 1672.16 | 2052.76 | 0.09 |
| RIVERSDALE | 114 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.61 | 273.60 | 274.62 | 0.000067 | 0.54 | 1975.17 | 2123.59 | 0.09 |
| RIVERSDALE | 114 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.61 | | 274.62 | 0.000063 | 0.53 | 2022.75 | 2108.26 | 0.09 |
| RIVERSDALE | 114 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.61 | 273.61 | 274.62 | 0.000069 | 0.55 | 1934.31 | 2108.62 | 0.09 |
| RIVERSDALE | 114 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.71 | 273.64 | 274.72 | 0.000065 | 0.54 | 2178.20 | 2164.16 | 0.09 |
| RIVERSDALE | 114 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000062 | 0.53 | 2231.97 | 2149.42 | 0.09 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W.S. Elev (m) | Cnt W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|-----------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 114 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.71 | 273.65 | 274.72 | 0.000067 | 0.55 | 2135.89 | 2149.78 | 0.09 |
| RIVERSDALE | 114 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.79 | 273.68 | 274.80 | 0.000066 | 0.56 | 2348.89 | 2202.77 | 0.09 |
| RIVERSDALE | 114 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.79 | | 274.80 | 0.000063 | 0.54 | 2407.93 | 2188.53 | 0.09 |
| RIVERSDALE | 114 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.79 | 273.69 | 274.80 | 0.000068 | 0.57 | 2305.35 | 2188.87 | 0.09 |
| RIVERSDALE | 114 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.14 | 273.82 | 275.15 | 0.000062 | 0.66 | 3148.12 | 2444.97 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.14 | | 275.15 | 0.000074 | 0.63 | 3216.74 | 2433.14 | 0.10 |
| RIVERSDALE | 114 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.14 | 273.83 | 275.15 | 0.000084 | 0.67 | 3100.51 | 2433.29 | 0.11 |
| RIVERSDALE | 113.5 | | | Bridge | | | | | | | | | |
| RIVERSDALE | 113 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.48 | | 274.48 | 0.000033 | 0.37 | 2260.53 | 2425.66 | 0.06 |
| RIVERSDALE | 113 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.48 | | 274.48 | 0.000034 | 0.38 | 2228.80 | 2409.75 | 0.07 |
| RIVERSDALE | 113 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.48 | | 274.48 | 0.000034 | 0.38 | 2229.60 | 2409.87 | 0.07 |
| RIVERSDALE | 113 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.61 | | 274.61 | 0.000034 | 0.39 | 2579.65 | 2470.68 | 0.07 |
| RIVERSDALE | 113 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.61 | | 274.61 | 0.000035 | 0.39 | 2546.14 | 2455.44 | 0.07 |
| RIVERSDALE | 113 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.61 | | 274.61 | 0.000035 | 0.39 | 2546.74 | 2455.52 | 0.07 |
| RIVERSDALE | 113 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000035 | 0.40 | 2824.36 | 2556.04 | 0.07 |
| RIVERSDALE | 113 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000036 | 0.41 | 2789.52 | 2541.28 | 0.07 |
| RIVERSDALE | 113 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000036 | 0.41 | 2790.04 | 2541.49 | 0.07 |
| RIVERSDALE | 113 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.79 | | 274.79 | 0.000037 | 0.42 | 3032.16 | 2569.68 | 0.07 |
| RIVERSDALE | 113 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.79 | | 274.79 | 0.000038 | 0.42 | 2996.16 | 2555.64 | 0.07 |
| RIVERSDALE | 113 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.79 | | 274.79 | 0.000038 | 0.42 | 2996.63 | 2555.67 | 0.07 |
| RIVERSDALE | 113 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000044 | 0.48 | 3946.33 | 2664.10 | 0.08 |
| RIVERSDALE | 113 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000045 | 0.49 | 3905.89 | 2652.29 | 0.08 |
| RIVERSDALE | 113 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000045 | 0.49 | 3906.19 | 2652.31 | 0.08 |
| RIVERSDALE | 112 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.48 | | 274.48 | 0.000067 | 0.53 | 1911.11 | 2644.64 | 0.09 |
| RIVERSDALE | 112 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.48 | | 274.48 | 0.000067 | 0.53 | 1911.11 | 2644.64 | 0.09 |
| RIVERSDALE | 112 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.48 | | 274.48 | 0.000067 | 0.53 | 1911.11 | 2644.64 | 0.09 |
| RIVERSDALE | 112 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.61 | | 274.61 | 0.000063 | 0.52 | 2258.87 | 2667.28 | 0.09 |
| RIVERSDALE | 112 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.61 | | 274.61 | 0.000063 | 0.52 | 2258.87 | 2667.28 | 0.09 |
| RIVERSDALE | 112 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.61 | | 274.61 | 0.000063 | 0.52 | 2258.87 | 2667.28 | 0.09 |
| RIVERSDALE | 112 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000059 | 0.51 | 2522.82 | 2688.57 | 0.09 |
| RIVERSDALE | 112 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000059 | 0.51 | 2522.82 | 2688.57 | 0.09 |
| RIVERSDALE | 112 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.71 | | 274.71 | 0.000059 | 0.51 | 2522.82 | 2688.57 | 0.09 |
| RIVERSDALE | 112 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.79 | | 274.79 | 0.000059 | 0.52 | 2741.62 | 2704.36 | 0.09 |
| RIVERSDALE | 112 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.79 | | 274.79 | 0.000059 | 0.52 | 2741.62 | 2704.36 | 0.09 |
| RIVERSDALE | 112 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.79 | | 274.79 | 0.000059 | 0.52 | 2741.62 | 2704.36 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 112 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.14 | | 275.14 | 0.000063 | 0.57 | 3709.20 | 2811.27 | 0.09 |
| RIVERSDALE | 111 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.47 | | 274.48 | 0.000081 | 0.59 | 1758.97 | 2651.55 | 0.10 |
| RIVERSDALE | 111 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.47 | | 274.48 | 0.000081 | 0.59 | 1758.97 | 2651.55 | 0.10 |
| RIVERSDALE | 111 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.47 | | 274.48 | 0.000081 | 0.59 | 1758.97 | 2651.55 | 0.10 |
| RIVERSDALE | 111 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.60 | | 274.61 | 0.000075 | 0.58 | 2109.77 | 2673.33 | 0.10 |
| RIVERSDALE | 111 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.60 | | 274.61 | 0.000075 | 0.58 | 2109.77 | 2673.33 | 0.10 |
| RIVERSDALE | 111 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.60 | | 274.61 | 0.000075 | 0.58 | 2109.77 | 2673.33 | 0.10 |
| RIVERSDALE | 111 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.70 | | 274.71 | 0.000070 | 0.57 | 2375.37 | 2689.79 | 0.09 |
| RIVERSDALE | 111 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.70 | | 274.71 | 0.000070 | 0.57 | 2375.37 | 2689.79 | 0.09 |
| RIVERSDALE | 111 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.70 | | 274.71 | 0.000070 | 0.57 | 2375.37 | 2689.79 | 0.09 |
| RIVERSDALE | 111 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.78 | | 274.79 | 0.000069 | 0.58 | 2594.44 | 2703.08 | 0.09 |
| RIVERSDALE | 111 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.78 | | 274.79 | 0.000069 | 0.58 | 2594.44 | 2703.08 | 0.09 |
| RIVERSDALE | 111 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.78 | | 274.79 | 0.000069 | 0.58 | 2594.44 | 2703.08 | 0.09 |
| RIVERSDALE | 111 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 111 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 111 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.13 | | 275.14 | 0.000072 | 0.62 | 3552.87 | 2765.19 | 0.10 |
| RIVERSDALE | 110 | 10-YR | EX-MDS | 295.10 | 270.86 | 274.47 | | 274.47 | 0.000063 | 0.52 | 1764.36 | 2593.21 | 0.09 |
| RIVERSDALE | 110 | 10-YR | PR-MDS | 295.10 | 270.86 | 274.47 | | 274.47 | 0.000063 | 0.52 | 1764.36 | 2593.21 | 0.09 |
| RIVERSDALE | 110 | 10-YR | PR 2-MDS | 295.10 | 270.86 | 274.47 | | 274.47 | 0.000063 | 0.52 | 1764.36 | 2593.21 | 0.09 |
| RIVERSDALE | 110 | 25-YR | EX-MDS | 357.90 | 270.86 | 274.60 | | 274.60 | 0.000059 | 0.52 | 2109.60 | 2640.59 | 0.09 |
| RIVERSDALE | 110 | 25-YR | PR-MDS | 357.90 | 270.86 | 274.60 | | 274.60 | 0.000059 | 0.52 | 2109.60 | 2640.59 | 0.09 |
| RIVERSDALE | 110 | 25-YR | PR 2-MDS | 357.90 | 270.86 | 274.60 | | 274.60 | 0.000059 | 0.52 | 2109.60 | 2640.59 | 0.09 |
| RIVERSDALE | 110 | 50-YR | EX-MDS | 407.00 | 270.86 | 274.70 | | 274.70 | 0.000056 | 0.51 | 2372.65 | 2661.79 | 0.08 |
| RIVERSDALE | 110 | 50-YR | PR-MDS | 407.00 | 270.86 | 274.70 | | 274.70 | 0.000056 | 0.51 | 2372.65 | 2661.79 | 0.08 |
| RIVERSDALE | 110 | 50-YR | PR 2-MDS | 407.00 | 270.86 | 274.70 | | 274.70 | 0.000056 | 0.51 | 2372.65 | 2661.79 | 0.08 |
| RIVERSDALE | 110 | 100-YR | EX-MDS | 458.50 | 270.86 | 274.78 | | 274.78 | 0.000056 | 0.52 | 2589.38 | 2677.63 | 0.08 |
| RIVERSDALE | 110 | 100-YR | PR-MDS | 458.50 | 270.86 | 274.78 | | 274.78 | 0.000056 | 0.52 | 2589.38 | 2677.63 | 0.08 |
| RIVERSDALE | 110 | 100-YR | PR 2-MDS | 458.50 | 270.86 | 274.78 | | 274.78 | 0.000056 | 0.52 | 2589.38 | 2677.63 | 0.08 |
| RIVERSDALE | 110 | REGIONAL | EX-MDS | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | PR-MDS | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 110 | REGIONAL | PR 2-MDS | 734.50 | 270.86 | 275.13 | | 275.13 | 0.000058 | 0.56 | 3578.03 | 3066.52 | 0.09 |
| RIVERSDALE | 109 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.45 | | 274.46 | 0.000114 | 0.70 | 1501.38 | 2986.09 | 0.12 |
| RIVERSDALE | 109 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.45 | | 274.46 | 0.000114 | 0.70 | 1501.38 | 2986.09 | 0.12 |
| RIVERSDALE | 109 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.45 | | 274.46 | 0.000114 | 0.70 | 1501.38 | 2986.09 | 0.12 |
| RIVERSDALE | 109 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.59 | | 274.59 | 0.000097 | 0.66 | 1908.05 | 3039.65 | 0.11 |
| RIVERSDALE | 109 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.59 | | 274.59 | 0.000097 | 0.66 | 1908.05 | 3039.65 | 0.11 |
| RIVERSDALE | 109 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.59 | | 274.59 | 0.000097 | 0.66 | 1908.05 | 3039.65 | 0.11 |
| RIVERSDALE | 109 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.69 | | 274.69 | 0.000086 | 0.63 | 2216.71 | 3079.72 | 0.11 |
| RIVERSDALE | 109 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.69 | | 274.69 | 0.000086 | 0.63 | 2216.71 | 3079.72 | 0.11 |
| RIVERSDALE | 109 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.69 | | 274.69 | 0.000086 | 0.63 | 2216.71 | 3079.72 | 0.11 |
| RIVERSDALE | 109 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.77 | | 274.77 | 0.000083 | 0.63 | 2470.98 | 3136.45 | 0.10 |
| RIVERSDALE | 109 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.77 | | 274.77 | 0.000083 | 0.63 | 2470.98 | 3136.45 | 0.10 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W S. Elev (m) | Crit W.S. (m) | E.G. Elev (m) | E.G. Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chl |
|------------|-----------|----------|----------|-------------------|------------------|------------------|------------------|------------------|---------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 109 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.77 | | 274.77 | 0.000083 | 0.63 | 2470.98 | 3136.45 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 109 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000079 | 0.65 | 3632.15 | 3530.13 | 0.10 |
| RIVERSDALE | 108 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.44 | | 274.45 | 0.000175 | 0.86 | 1334.01 | 2635.76 | 0.15 |
| RIVERSDALE | 108 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.44 | | 274.45 | 0.000175 | 0.86 | 1334.01 | 2635.76 | 0.15 |
| RIVERSDALE | 108 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.44 | | 274.45 | 0.000175 | 0.86 | 1334.01 | 2635.76 | 0.15 |
| RIVERSDALE | 108 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.58 | | 274.59 | 0.000145 | 0.80 | 1729.96 | 3083.67 | 0.14 |
| RIVERSDALE | 108 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.58 | | 274.59 | 0.000145 | 0.80 | 1729.96 | 3083.67 | 0.14 |
| RIVERSDALE | 108 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.58 | | 274.59 | 0.000145 | 0.80 | 1729.96 | 3083.67 | 0.14 |
| RIVERSDALE | 108 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.68 | | 274.69 | 0.000123 | 0.75 | 2048.86 | 3143.52 | 0.13 |
| RIVERSDALE | 108 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.68 | | 274.69 | 0.000123 | 0.75 | 2048.86 | 3143.52 | 0.13 |
| RIVERSDALE | 108 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.68 | | 274.69 | 0.000123 | 0.75 | 2048.86 | 3143.52 | 0.13 |
| RIVERSDALE | 108 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.76 | | 274.77 | 0.000114 | 0.74 | 2310.13 | 3187.59 | 0.12 |
| RIVERSDALE | 108 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.76 | | 274.77 | 0.000114 | 0.74 | 2310.13 | 3187.59 | 0.12 |
| RIVERSDALE | 108 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.76 | | 274.77 | 0.000114 | 0.74 | 2310.13 | 3187.59 | 0.12 |
| RIVERSDALE | 108 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.08 | 3556.31 | 0.11 |
| RIVERSDALE | 108 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.08 | 3556.31 | 0.11 |
| RIVERSDALE | 108 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.12 | | 275.12 | 0.000097 | 0.72 | 3487.08 | 3556.31 | 0.11 |
| RIVERSDALE | 107 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.43 | | 274.44 | 0.000211 | 0.93 | 1188.27 | 2179.20 | 0.16 |
| RIVERSDALE | 107 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.43 | | 274.44 | 0.000211 | 0.93 | 1188.27 | 2179.20 | 0.16 |
| RIVERSDALE | 107 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.43 | | 274.44 | 0.000211 | 0.93 | 1188.27 | 2179.20 | 0.16 |
| RIVERSDALE | 107 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.57 | | 274.58 | 0.000176 | 0.87 | 1515.39 | 2536.52 | 0.15 |
| RIVERSDALE | 107 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.57 | | 274.58 | 0.000176 | 0.87 | 1515.39 | 2536.52 | 0.15 |
| RIVERSDALE | 107 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.57 | | 274.58 | 0.000176 | 0.87 | 1515.39 | 2536.52 | 0.15 |
| RIVERSDALE | 107 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.67 | | 274.68 | 0.000154 | 0.83 | 1789.24 | 2696.98 | 0.14 |
| RIVERSDALE | 107 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.67 | | 274.68 | 0.000154 | 0.83 | 1789.24 | 2696.98 | 0.14 |
| RIVERSDALE | 107 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.67 | | 274.68 | 0.000154 | 0.83 | 1789.24 | 2696.98 | 0.14 |
| RIVERSDALE | 107 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.76 | | 274.76 | 0.000145 | 0.82 | 2015.31 | 2757.01 | 0.14 |
| RIVERSDALE | 107 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.76 | | 274.76 | 0.000145 | 0.82 | 2015.31 | 2757.01 | 0.14 |
| RIVERSDALE | 107 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.76 | | 274.76 | 0.000145 | 0.82 | 2015.31 | 2757.01 | 0.14 |
| RIVERSDALE | 107 | REGIONAL | EX-MDS | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.62 | 3540.59 | 0.13 |
| RIVERSDALE | 107 | REGIONAL | PR-MDS | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.62 | 3540.59 | 0.13 |
| RIVERSDALE | 107 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 275.11 | | 275.12 | 0.000129 | 0.82 | 3096.62 | 3540.59 | 0.13 |
| RIVERSDALE | 106 | 10-YR | EX-MDS | 295.10 | 270.01 | 274.40 | | 274.41 | 0.000192 | 0.98 | 943.90 | 1376.04 | 0.16 |
| RIVERSDALE | 106 | 10-YR | PR-MDS | 295.10 | 270.01 | 274.40 | | 274.41 | 0.000192 | 0.98 | 943.90 | 1376.04 | 0.16 |
| RIVERSDALE | 106 | 10-YR | PR 2-MDS | 295.10 | 270.01 | 274.40 | | 274.41 | 0.000192 | 0.98 | 943.90 | 1376.04 | 0.16 |
| RIVERSDALE | 106 | 25-YR | EX-MDS | 357.90 | 270.01 | 274.54 | | 274.55 | 0.000176 | 0.96 | 1155.13 | 1623.42 | 0.15 |
| RIVERSDALE | 106 | 25-YR | PR-MDS | 357.90 | 270.01 | 274.54 | | 274.55 | 0.000176 | 0.96 | 1155.13 | 1623.42 | 0.15 |
| RIVERSDALE | 106 | 25-YR | PR 2-MDS | 357.90 | 270.01 | 274.54 | | 274.55 | 0.000176 | 0.96 | 1155.13 | 1623.42 | 0.15 |
| RIVERSDALE | 106 | 50-YR | EX-MDS | 407.00 | 270.01 | 274.64 | | 274.66 | 0.000163 | 0.94 | 1348.73 | 1932.61 | 0.15 |
| RIVERSDALE | 106 | 50-YR | PR-MDS | 407.00 | 270.01 | 274.64 | | 274.66 | 0.000163 | 0.94 | 1348.73 | 1932.61 | 0.15 |
| RIVERSDALE | 106 | 50-YR | PR 2-MDS | 407.00 | 270.01 | 274.64 | | 274.66 | 0.000163 | 0.94 | 1348.73 | 1932.61 | 0.15 |
| RIVERSDALE | 106 | 100-YR | EX-MDS | 458.50 | 270.01 | 274.73 | | 274.74 | 0.000158 | 0.94 | 1520.42 | 2130.40 | 0.15 |
| RIVERSDALE | 106 | 100-YR | PR-MDS | 458.50 | 270.01 | 274.73 | | 274.74 | 0.000158 | 0.94 | 1520.42 | 2130.40 | 0.15 |
| RIVERSDALE | 106 | 100-YR | PR 2-MDS | 458.50 | 270.01 | 274.73 | | 274.74 | 0.000158 | 0.94 | 1520.42 | 2130.40 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | EX-MDS | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.00 | 3631.20 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | PR-MDS | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.00 | 3631.20 | 0.15 |
| RIVERSDALE | 106 | REGIONAL | PR 2-MDS | 734.50 | 270.01 | 275.08 | | 275.09 | 0.000157 | 0.99 | 2482.00 | 3631.20 | 0.15 |
| RIVERSDALE | 105 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.33 | | 274.36 | 0.000398 | 1.27 | 787.45 | 626.91 | 0.22 |
| RIVERSDALE | 105 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.33 | | 274.36 | 0.000398 | 1.27 | 787.45 | 626.91 | 0.22 |
| RIVERSDALE | 105 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.33 | | 274.36 | 0.000398 | 1.27 | 787.45 | 626.91 | 0.22 |
| RIVERSDALE | 105 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.46 | | 274.50 | 0.000480 | 1.43 | 873.83 | 687.87 | 0.25 |
| RIVERSDALE | 105 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.46 | | 274.50 | 0.000480 | 1.43 | 873.83 | 687.87 | 0.25 |
| RIVERSDALE | 105 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.46 | | 274.50 | 0.000480 | 1.43 | 873.83 | 687.87 | 0.25 |
| RIVERSDALE | 105 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.56 | | 274.60 | 0.000519 | 1.51 | 946.88 | 740.63 | 0.26 |
| RIVERSDALE | 105 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.56 | | 274.60 | 0.000519 | 1.51 | 946.88 | 740.63 | 0.26 |
| RIVERSDALE | 105 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.56 | | 274.60 | 0.000519 | 1.51 | 946.88 | 740.63 | 0.26 |
| RIVERSDALE | 105 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.64 | | 274.69 | 0.000555 | 1.59 | 1009.21 | 799.06 | 0.27 |
| RIVERSDALE | 105 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.64 | | 274.69 | 0.000555 | 1.59 | 1009.21 | 799.06 | 0.27 |
| RIVERSDALE | 105 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.64 | | 274.69 | 0.000555 | 1.59 | 1009.21 | 799.06 | 0.27 |
| RIVERSDALE | 105 | REGIONAL | EX-MDS | 734.50 | 271.00 | 274.98 | | 275.04 | 0.000698 | 1.89 | 1346.88 | 1199.02 | 0.30 |
| RIVERSDALE | 105 | REGIONAL | PR-MDS | 734.50 | 271.00 | 274.98 | | 275.04 | 0.000698 | 1.89 | 1346.88 | 1199.02 | 0.30 |
| RIVERSDALE | 105 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 274.98 | | 275.04 | 0.000698 | 1.89 | 1346.88 | 1199.02 | 0.30 |
| RIVERSDALE | 104 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.27 | | 274.30 | 0.000440 | 1.31 | 555.56 | 515.89 | 0.23 |
| RIVERSDALE | 104 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.27 | | 274.30 | 0.000440 | 1.31 | 555.56 | 515.89 | 0.23 |
| RIVERSDALE | 104 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.27 | | 274.30 | 0.000440 | 1.31 | 555.56 | 515.89 | 0.23 |
| RIVERSDALE | 104 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.39 | | 274.42 | 0.000516 | 1.46 | 621.19 | 580.09 | 0.25 |
| RIVERSDALE | 104 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.39 | | 274.42 | 0.000516 | 1.46 | 621.19 | 580.09 | 0.25 |
| RIVERSDALE | 104 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.39 | | 274.42 | 0.000516 | 1.46 | 621.19 | 580.09 | 0.25 |
| RIVERSDALE | 104 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.48 | | 274.52 | 0.000551 | 1.53 | 680.07 | 655.83 | 0.26 |
| RIVERSDALE | 104 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.48 | | 274.52 | 0.000551 | 1.53 | 680.07 | 655.83 | 0.26 |
| RIVERSDALE | 104 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.48 | | 274.52 | 0.000551 | 1.53 | 680.07 | 655.83 | 0.26 |
| RIVERSDALE | 104 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.55 | | 274.60 | 0.000603 | 1.63 | 732.14 | 765.65 | 0.28 |
| RIVERSDALE | 104 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.55 | | 274.60 | 0.000603 | 1.63 | 732.14 | 765.65 | 0.28 |
| RIVERSDALE | 104 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.55 | | 274.60 | 0.000603 | 1.63 | 732.14 | 765.65 | 0.28 |
| RIVERSDALE | 104 | REGIONAL | EX-MDS | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.68 | 907.03 | 0.30 |
| RIVERSDALE | 104 | REGIONAL | PR-MDS | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.68 | 907.03 | 0.30 |
| RIVERSDALE | 104 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 274.88 | | 274.93 | 0.000689 | 1.84 | 1004.68 | 907.03 | 0.30 |

| Reach | River Sta | Profile | Plan | Q Total (m3/s) | Min Ch El (m) | W S Elev (m) | Cnt W S (m) | E G Elev (m) | E G Slope (m/m) | Vel Chnl (m/s) | Flow Area (m2) | Top Width (m) | Froude # Chi |
|------------|-----------|----------|----------|-------------------|------------------|-----------------|----------------|-----------------|--------------------|-------------------|-------------------|------------------|--------------|
| RIVERSDALE | 103 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.13 | | 274.19 | 0.000768 | 1.67 | 510.43 | 652.53 | 0.30 |
| RIVERSDALE | 103 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.13 | | 274.19 | 0.000768 | 1.67 | 510.43 | 652.53 | 0.30 |
| RIVERSDALE | 103 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.13 | | 274.19 | 0.000768 | 1.67 | 510.43 | 652.53 | 0.30 |
| RIVERSDALE | 103 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.25 | | 274.31 | 0.000785 | 1.73 | 588.05 | 671.14 | 0.31 |
| RIVERSDALE | 103 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.25 | | 274.31 | 0.000785 | 1.73 | 588.05 | 671.14 | 0.31 |
| RIVERSDALE | 103 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.25 | | 274.31 | 0.000785 | 1.73 | 588.05 | 671.14 | 0.31 |
| RIVERSDALE | 103 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.35 | | 274.41 | 0.000737 | 1.71 | 659.24 | 687.95 | 0.30 |
| RIVERSDALE | 103 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.35 | | 274.41 | 0.000737 | 1.71 | 659.24 | 687.95 | 0.30 |
| RIVERSDALE | 103 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.35 | | 274.41 | 0.000737 | 1.71 | 659.24 | 687.95 | 0.30 |
| RIVERSDALE | 103 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.42 | | 274.48 | 0.000769 | 1.77 | 705.97 | 697.95 | 0.31 |
| RIVERSDALE | 103 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.42 | | 274.48 | 0.000769 | 1.77 | 705.97 | 697.95 | 0.31 |
| RIVERSDALE | 103 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.42 | | 274.48 | 0.000769 | 1.77 | 705.97 | 697.95 | 0.31 |
| RIVERSDALE | 103 | REGIONAL | EX-MDS | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.91 | 832.33 | 0.34 |
| RIVERSDALE | 103 | REGIONAL | PR-MDS | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.91 | 832.33 | 0.34 |
| RIVERSDALE | 103 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 274.72 | | 274.79 | 0.000897 | 2.03 | 940.91 | 832.33 | 0.34 |
| RIVERSDALE | 102 | 10-YR | EX-MDS | 295.10 | 271.00 | 274.04 | | 274.09 | 0.000722 | 1.60 | 654.82 | 1052.23 | 0.29 |
| RIVERSDALE | 102 | 10-YR | PR-MDS | 295.10 | 271.00 | 274.04 | | 274.09 | 0.000722 | 1.60 | 654.82 | 1052.23 | 0.29 |
| RIVERSDALE | 102 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 274.04 | | 274.09 | 0.000722 | 1.60 | 654.82 | 1052.23 | 0.29 |
| RIVERSDALE | 102 | 25-YR | EX-MDS | 357.90 | 271.00 | 274.17 | | 274.21 | 0.000647 | 1.56 | 789.76 | 1064.97 | 0.28 |
| RIVERSDALE | 102 | 25-YR | PR-MDS | 357.90 | 271.00 | 274.17 | | 274.21 | 0.000647 | 1.56 | 789.76 | 1064.97 | 0.28 |
| RIVERSDALE | 102 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 274.17 | | 274.21 | 0.000647 | 1.56 | 789.76 | 1064.97 | 0.28 |
| RIVERSDALE | 102 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.28 | | 274.32 | 0.000551 | 1.47 | 915.32 | 1077.76 | 0.26 |
| RIVERSDALE | 102 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.28 | | 274.32 | 0.000551 | 1.47 | 915.32 | 1077.76 | 0.26 |
| RIVERSDALE | 102 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.28 | | 274.32 | 0.000551 | 1.47 | 915.32 | 1077.76 | 0.26 |
| RIVERSDALE | 102 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.35 | | 274.38 | 0.000559 | 1.51 | 987.26 | 1084.34 | 0.26 |
| RIVERSDALE | 102 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.35 | | 274.38 | 0.000559 | 1.51 | 987.26 | 1084.34 | 0.26 |
| RIVERSDALE | 102 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.35 | | 274.38 | 0.000559 | 1.51 | 987.26 | 1084.34 | 0.26 |
| RIVERSDALE | 102 | REGIONAL | EX-MDS | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.57 | 1114.23 | 0.27 |
| RIVERSDALE | 102 | REGIONAL | PR-MDS | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.57 | 1114.23 | 0.27 |
| RIVERSDALE | 102 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 274.65 | | 274.69 | 0.000590 | 1.64 | 1319.57 | 1114.23 | 0.27 |
| RIVERSDALE | 101 | 10-YR | EX-MDS | 295.10 | 271.97 | 273.96 | | 273.97 | 0.000378 | 0.87 | 811.14 | 993.83 | 0.20 |
| RIVERSDALE | 101 | 10-YR | PR-MDS | 295.10 | 271.97 | 273.96 | | 273.97 | 0.000378 | 0.87 | 811.14 | 993.83 | 0.20 |
| RIVERSDALE | 101 | 10-YR | PR 2-MDS | 295.10 | 271.97 | 273.96 | | 273.97 | 0.000378 | 0.87 | 811.14 | 993.83 | 0.20 |
| RIVERSDALE | 101 | 25-YR | EX-MDS | 357.90 | 271.97 | 274.07 | | 274.09 | 0.000424 | 0.96 | 932.46 | 1060.14 | 0.21 |
| RIVERSDALE | 101 | 25-YR | PR-MDS | 357.90 | 271.97 | 274.07 | | 274.09 | 0.000424 | 0.96 | 932.46 | 1060.14 | 0.21 |
| RIVERSDALE | 101 | 25-YR | PR 2-MDS | 357.90 | 271.97 | 274.07 | | 274.09 | 0.000424 | 0.96 | 932.46 | 1060.14 | 0.21 |
| RIVERSDALE | 101 | 50-YR | EX-MDS | 407.00 | 271.97 | 274.20 | | 274.21 | 0.000362 | 0.92 | 1071.00 | 1108.66 | 0.20 |
| RIVERSDALE | 101 | 50-YR | PR-MDS | 407.00 | 271.97 | 274.20 | | 274.21 | 0.000362 | 0.92 | 1071.00 | 1108.66 | 0.20 |
| RIVERSDALE | 101 | 50-YR | PR 2-MDS | 407.00 | 271.97 | 274.20 | | 274.21 | 0.000362 | 0.92 | 1071.00 | 1108.66 | 0.20 |
| RIVERSDALE | 101 | 100-YR | EX-MDS | 458.50 | 271.97 | 274.26 | | 274.28 | 0.000383 | 0.97 | 1139.95 | 1132.31 | 0.20 |
| RIVERSDALE | 101 | 100-YR | PR-MDS | 458.50 | 271.97 | 274.26 | | 274.28 | 0.000383 | 0.97 | 1139.95 | 1132.31 | 0.20 |
| RIVERSDALE | 101 | 100-YR | PR 2-MDS | 458.50 | 271.97 | 274.26 | | 274.28 | 0.000383 | 0.97 | 1139.95 | 1132.31 | 0.20 |
| RIVERSDALE | 101 | REGIONAL | EX-MDS | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000464 | 1.15 | 1474.89 | 1229.19 | 0.23 |
| RIVERSDALE | 101 | REGIONAL | PR-MDS | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000464 | 1.15 | 1474.89 | 1229.19 | 0.23 |
| RIVERSDALE | 101 | REGIONAL | PR 2-MDS | 734.50 | 271.97 | 274.55 | | 274.57 | 0.000464 | 1.15 | 1474.89 | 1229.19 | 0.23 |
| RIVERSDALE | 100 | 10-YR | EX-MDS | 295.10 | 271.00 | 273.84 | 272.98 | 273.90 | 0.001002 | 1.73 | 625.63 | 897.35 | 0.34 |
| RIVERSDALE | 100 | 10-YR | PR-MDS | 295.10 | 271.00 | 273.84 | 272.98 | 273.90 | 0.001002 | 1.73 | 625.63 | 897.35 | 0.34 |
| RIVERSDALE | 100 | 10-YR | PR 2-MDS | 295.10 | 271.00 | 273.84 | 272.98 | 273.90 | 0.001002 | 1.73 | 625.63 | 897.35 | 0.34 |
| RIVERSDALE | 100 | 25-YR | EX-MDS | 357.90 | 271.00 | 273.96 | 273.53 | 274.01 | 0.001000 | 1.78 | 735.11 | 976.12 | 0.34 |
| RIVERSDALE | 100 | 25-YR | PR-MDS | 357.90 | 271.00 | 273.96 | 273.53 | 274.01 | 0.001000 | 1.78 | 735.11 | 976.12 | 0.34 |
| RIVERSDALE | 100 | 25-YR | PR 2-MDS | 357.90 | 271.00 | 273.96 | 273.53 | 274.01 | 0.001000 | 1.78 | 735.11 | 976.12 | 0.34 |
| RIVERSDALE | 100 | 50-YR | EX-MDS | 407.00 | 271.00 | 274.09 | 273.60 | 274.15 | 0.001000 | 1.83 | 893.50 | 1304.98 | 0.34 |
| RIVERSDALE | 100 | 50-YR | PR-MDS | 407.00 | 271.00 | 274.09 | 273.60 | 274.15 | 0.001000 | 1.83 | 893.50 | 1304.98 | 0.34 |
| RIVERSDALE | 100 | 50-YR | PR 2-MDS | 407.00 | 271.00 | 274.09 | 273.60 | 274.15 | 0.001000 | 1.83 | 893.50 | 1304.98 | 0.34 |
| RIVERSDALE | 100 | 100-YR | EX-MDS | 458.50 | 271.00 | 274.15 | 272.94 | 274.21 | 0.001002 | 1.86 | 975.77 | 1330.40 | 0.35 |
| RIVERSDALE | 100 | 100-YR | PR-MDS | 458.50 | 271.00 | 274.15 | 272.94 | 274.21 | 0.001002 | 1.86 | 975.77 | 1330.40 | 0.35 |
| RIVERSDALE | 100 | 100-YR | PR 2-MDS | 458.50 | 271.00 | 274.15 | 272.94 | 274.21 | 0.001002 | 1.86 | 975.77 | 1330.40 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | EX-MDS | 734.50 | 271.00 | 274.44 | 273.90 | 274.49 | 0.001001 | 1.98 | 1370.32 | 1425.34 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | PR-MDS | 734.50 | 271.00 | 274.44 | 273.90 | 274.49 | 0.001001 | 1.98 | 1370.32 | 1425.34 | 0.35 |
| RIVERSDALE | 100 | REGIONAL | PR 2-MDS | 734.50 | 271.00 | 274.44 | 273.90 | 274.49 | 0.001001 | 1.98 | 1370.32 | 1425.34 | 0.35 |

**APPENDIX F:
PHOTOS – EXISTING BRIDGE**



Plate 1 – View of the structure from the east.



Plate 2 – View of the structure from the north.



Plate 3 – Large crack in north-east wingwall



Plate 4 – Cross beams are heavily corroded on underside of deck



Plate 5 – Wingwall has spalled exposing reinforcing steel.



Photo 1 – Downstream view of the structure from the east.



Photo 2 – Downstream view of the structure from the east.



Photo 3 – Upstream view of the structure from the east.



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SENT ELECTRONICALLY ONLY (swatson@brockton.ca)

April 18, 2018

Municipality of South Bruce
21 Gordon Street
Teeswater, Ontario
N0G 2S0

ATTENTION: Sonya Watson, CAO / Clerk

Dear Ms. Watson,

RE: Bridge No. 0002 (Riversdale Bridge) Draft Floodplain Analysis Report (GMBP File: 212326)
Draft Floodplain Analysis Report for Agency Review
Riversdale Bridge (0002)
Geographic Township of Greenock
Municipality of Brockton

This correspondence is in response to the receipt of the package with the cover letter dated February 1, 2018 received by Saugeen Valley Conservation Authority (SVCA) for Agency Review on February 2, 2018 for the above noted structure alternatives.

SVCA staff have reviewed the draft report dated February 2018. SVCA staff will make points after directly quoting in bold from the report for ease of reference.

Floodplain Backwater Analysis and Hydrology

1. **Page 2 of 6: Preliminary HEC-RAS cross-sections were developed using publicly available resources, including Bruce County Maps (1m elevation contours) and Ontario Base Map data.**

The Flood Model Cross-Section Location Plan shows 1 m intervals for the contours. In the opinion of the Engineer, are Bruce County's 1 m elevation contours from a 10 m DEM? If this is the case can they be considered accurate?

2. **Page 2 of 6: The MIDUSS model was developed using intensity-duration-frequency (IDF) data per the Mount Forest IDF station for the 10 to 100-year storm events.**

In the opinion of the Engineer, is the MIDUSS model and IDF appropriate for use in this situation and this location?

3. **Page 3 of 6: If Greenock Creek overtops its banks during a flood event, the flood waters would appear to drain westerly to the Teeswater River (downstream of the Sideroad 20 Bridge No. 0002 through the lower**



Watershed Member Municipalities

Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands, Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce, Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North, Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

lying lands and towards the downstream limit of the watershed area...

SVCA staff is in agreement with this assessment. In the opinion of the Engineer, how does that affect localized flooding that will affect Options 2 and 3 (specifically the road realignment of Sideroad 20)?

4. Table 2 - HEC-RAS Floodplain Model Water Surface Elevations (m)

Page 5 of 6: ...within the modelled area, are typically unchanged by either of the design alternatives.

Page 6 of 6: The relatively small geometry changes associated with the design alternatives, including an extension of Sideroad 20, have a negligible impact on the study area floodplain dynamics...

SVCA staff acknowledge that the extension of Sideroad 20 South may not dramatically affect the floodplain of the Teeswater River and Greenock Creek over the extent of the larger watershed area, but the ability of the local area to absorb the extra backwater flow has not been adequately addressed. Furthermore, it is not clear what parameters were used to model the conditions for the addition of fill for the Sideroad 20 extension and how this addition affects the floodplain area, wetland and flood elevations from displaced floodwaters.

Regardless, the extension of Sideroad 20 South through the wetland will affect the hydrology of the unevaluated wetland (swamp) and the Conservation of Land which is defined in the SVCA policy manual as “the protection, preservation, management or restoration of lands within the watershed ecosystem for the purposes of maintaining or enhancing the natural features and hydrologic and ecological functions with the watershed...”

SVCA staff would only agree to consider the alternate designs (those which include the Sideroad 20 South extension) with a detailed Environmental Impact Study (EIS) to include an overview of the natural features and functions of the wetland that may be impacted by the proposal, which could include, but may not be limited to:

- The groundwater recharge, discharge, quality and quantity, including flow paths and contributions
- Surface water quality and quantity, including flow paths and seasonal contributions from Greenock Creek
- Detailed description of the natural environment including a biophysical, hydrologic and hydrogeologic inventory and analysis
- Description of the Significant Habitat of endangered, threatened and species of concern
- Significant Wildlife habitat analysis

As mentioned in the 1986 and 2003 SVCA comments, the new road will alter the floodplain to some extent and the west side of the road bed will encroach into the Teeswater river bank. According to the SVCA Policy Manual, SVCA staff would require a complete application outlining how the proposal outlines the control of flooding, erosion, pollution and the conservation of land. Some of the further information that would need to be considered and included for SVCA review would include but may not be limited to:

- What volume of fill would be required for the new road construction, how does this volume of fill affect the floodwaters and what measures would be put in place to allow for the movement of waters east to west under the road

- Run the model (or indicate what parameters were used for the existing analysis) with the proposed road width including the road allowance width and proposed elevation
- Cross section with the road elevation, centerline profile and relief culvert locations or other structures that allow for unimpeded floodwater movement
- Soil surveys to indicate the depth of removal of unsuitable soils and disposal location
- Teeswater River bank reconstruction and protection measures
- An Environmental Impact Study prepared based on the specific plans
- Information on the removal of the existing Bridge if proposed and its potential replacement showing how the design doesn't alter the floodplain unacceptably, adequately addresses the same floodwater events and outlines the cut and fill equalization plan
- A SVCA Application to Alter a Watercourse, a SVCA Application to Alter a Regulated Area and related review fees

Other Agency Comments

In the past, Conservation Authorities served as the first point of contact and the local service provider for review of Section 35 of the previous version of the Fisheries Act and had entered into agreements with Fisheries and Oceans Canada to facilitate this process. Changes to the Fisheries Act effective November 25, 2013, have resulted in the cancellation of these agreements. It is now the responsibility of the proponent to contact the Department of Fisheries and Oceans at 1-855-852-8320 or <http://www.dfo-mpo.gc.ca/pnw-ppe/index-eng.html> to ensure their project addresses the Fisheries Act.

Conclusion

Although this report has suggested that surface water elevations are expected to be generally unchanged or negligibly increased from existing conditions, SVCA staff are of the opinion that the assessment tools may not have been strident enough to address the backwater flooding from Greenock Creek and the potential impacts from such, especially when smaller flood events much smaller than the Regulatory Event cause conditions where floodwaters have been observed by SVCA staff to be level with sideroad 20 just east of the existing Bridge No. 0002.

SVCA staff recommend that the alternatives that contain extending Sideroad 20 North are not included for consideration, but you may provide an Application for SVCA review at any time.

Sincerely,



Michelle Gallant
Regulations Officer
Saugeen Conservation



Watershed Member Municipalities

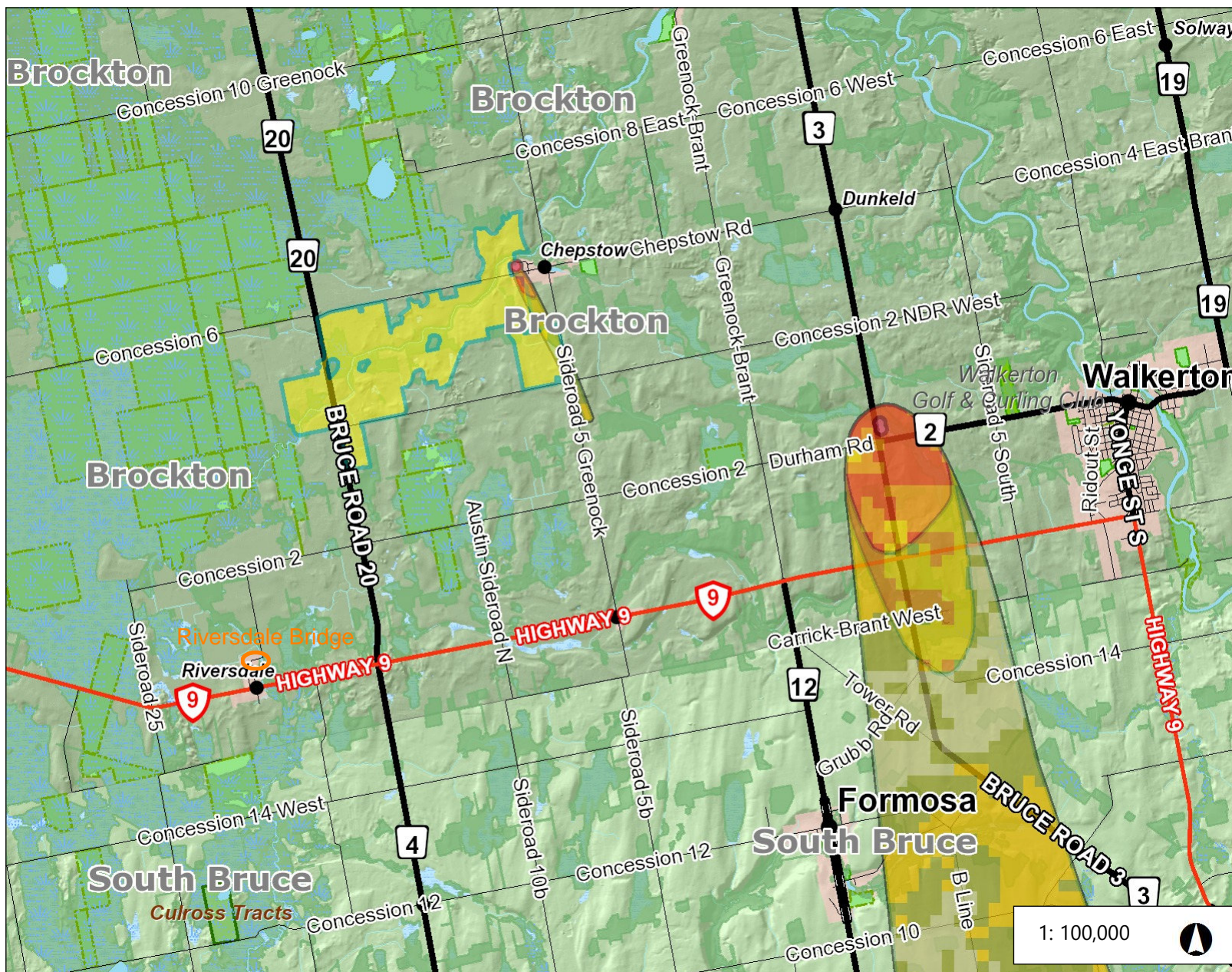
Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands, Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce, Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North, Town of Saugeen Shores, Township of Southgate, Municipality of West Grey

MG/

cc: John Strader, Municipality of Brockton (via e-mail)
John Slocombe, P. Eng., G.M. Blue Plan Engineering (via e-mail)
Brent Willis, P. Eng., G.M. Blue Plan Engineering (via e-mail)
Dan Gieruszak, Authority Member, SVCA (via e-mail)

Watershed Member Municipalities

Municipality of Arran-Elderslie, Municipality of Brockton, Township of Chatsworth, Municipality of Grey Highlands,
Town of Hanover, Township of Howick, Municipality of Morris-Turnberry, Municipality of South Bruce,
Township of Huron-Kinloss, Municipality of Kincardine, Town of Minto, Township of Wellington North,
Town of Saugeen Shores, Township of Southgate, Municipality of West Grey



Legend

Intake Protection Zone

- 4 - 5.9
- 6 - 7.9
- 8 - 9.9
- 10

Vulnerability Scores

- Level 2
- Level 4
- Level 6
- Level 8
- Level 10

WHPA E Vulnerability

- 6 - 7.9
- 8 - 9.9

Wellhead Protection Area Boundaries

- Zone A - 100m Buffer
- Zone B - 2 yr ToT
- Zone C - 10 yr ToT
- Zone D - 25 yr ToT

Event-based Areas

- 2000 L
- 3000 L
- 5000 L
- 7500 L
- 8000 L
- 10000 L
- 12000 L
- 13000 L
- 15000 L
- 22500 L
- 25000 L
- 50000 L
- 100000 L

- Ferry
- Provincial Highway
- County Road

Notes

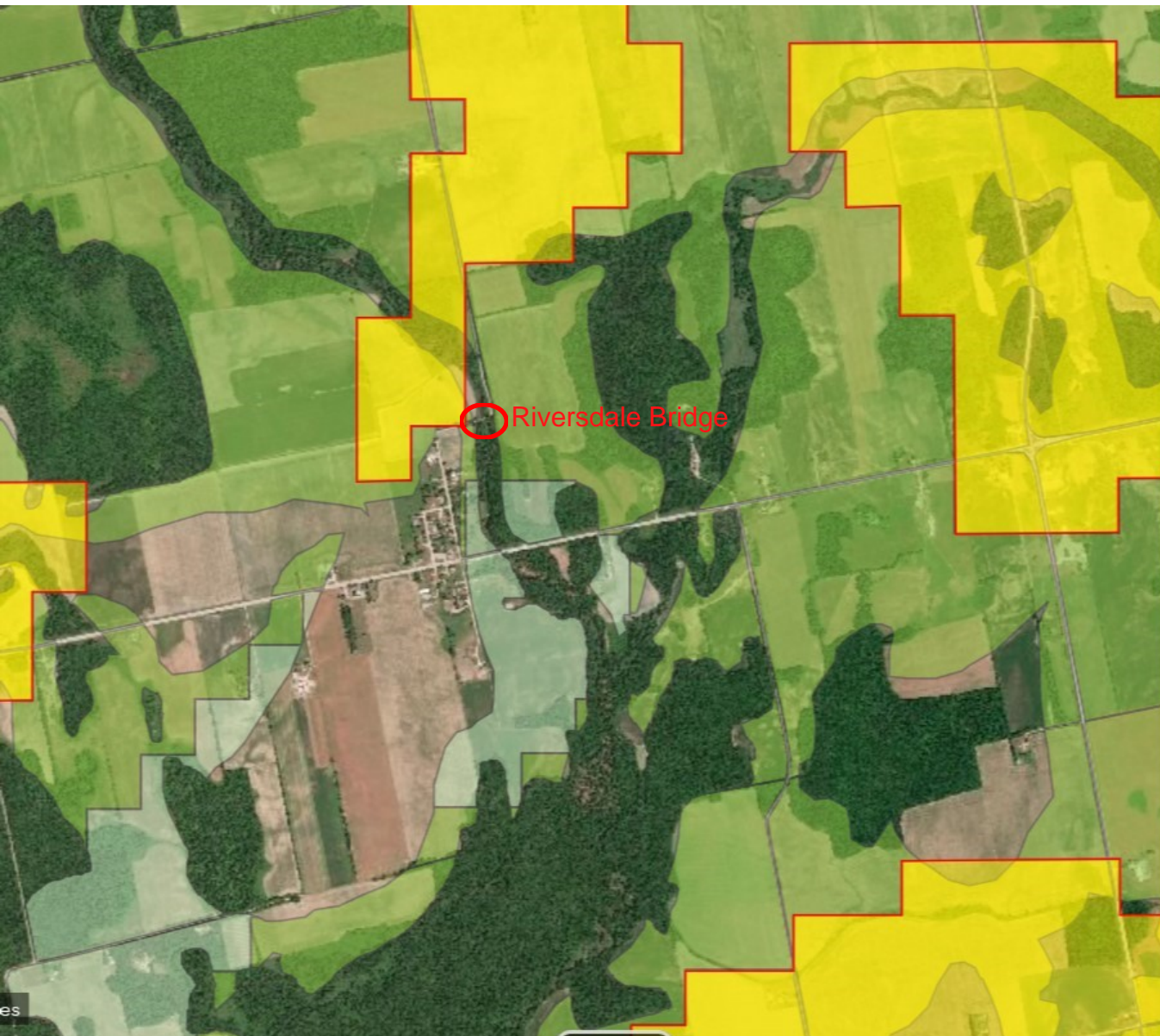
Source Water Protection

5.1 0 2.54 5.1 Kilometers

NAD_1983_UTM_Zone_17N
© 2020 County of Bruce

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION



Legend

Highly Vulnerable Aquifer Vulnerability



6

Significant Groundwater Recharge Area Vulnerability



6



4



2



October 22, 2020

Our File: 212326

Via Email: c.seider@waterprotection.ca

Drinking Water Source Protection
c/o Grey Sauble Conservation Authority
Risk Management Office
237897 Inglis Falls Road, RR#4
Owen Sound, ON N4K 5N6

Attention: Mr. Carl Seider

Re: Source Water Protection Consultation
Greenock Bridge No.0002
Riversdale, Municipality of Brockton

Dear Carl,

GM BluePlan Engineering has been retained by the Municipality of Brockton to undertake a Schedule 'B' Municipal Class Environmental Assessment (EA) planning process to address the deteriorated condition of Bridge No.0002 (i.e. Riversdale Bridge) located just north of Highway 9, centrally between Walkerton and Kincardine. A Project File for the bridge has been prepared to address the EA process (Municipal Engineers Association, 2015) and is available on the Municipality's website. The Project File discusses the findings, to date, of Phase 1 and, in part, Phase 2 of the Environmental Assessment.

As a simplified summary, the project proposes bridge removal and may result in road works within the existing rights-of-way, including:

- Complete bridge removal,
- General road works including regrading and minor alterations, and
- Landscaping of adjacent areas.

The creation of lands that would include chemical or fuel storage are not included as part of this plan.

Based on our preliminary review, the Study Area is not situated within a wellhead protection area (WHPA) or intake protection zone (IPZ). However, the Study Area is bordered by a Significant Groundwater Recharge Area (SGRA) with a vulnerability score of 4.

We have reviewed the recommended bridge removal and associated activities in relation to the *Tables for Drinking Water Threats*. Based on the potential scope of the project, it is not anticipated that:

- i. Any project activities will be considered a prescribed drinking water threat; or
- ii. Any activities will change or create new vulnerable areas.



As part of the EA process, we are reviewing the project with respect to requirements under the Clean Water Act. At this time, we are requesting confirmation of the above, as well as whether you are aware of any other potential considerations and policies in the Source Protection Plan that may apply to the project.

Should you have any questions, please feel free to contact our office.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in black ink, appearing to read 'M. Nelson'.

Matthew Nelson, P.Eng., P.Geo.
AN/kd

cc: Municipality of Brockton: Gregg Furtney, via Email – g.furtney@brockton.ca
File No. 212326

APPENDIX F:
CULTURAL ENVIRONMENT – SUPPORTING INFORMATION

**STAGE 1 ARCHAEOLOGICAL ASSESSMENT
PROPOSED BRIDGE REPLACEMENT OR UPGRADE
PART LOTS 30 AND 31, CONCESSION 1 NDR
GEOGRAPHIC TOWNSHIP OF GREENOCK
MUNICIPALITY OF BROCKTON
BRUCE COUNTY (FORMER SAUGEEN COUNTY)
ORIGINAL REPORT**

Prepared for:

**County of Bruce
and
Ministry of Tourism, Culture and Sport**

**SCARLETT JANUSAS ARCHAEOLOGY INC.
269 Cameron Lake Road, Tobermory, Ontario, N0H 2R0
phone 519-596-8243 mobile 519-374-1119
jscarlett@amtelecom.net
www.actionarchaeology.ca**



**License # P027, PIF #P027-0315-2017
July 11, 2017**

©

Executive Summary

The proponent retained the services of Scarlett Janusas Archaeology Inc. (SJA) to conduct a Stage 1 archaeological resource assessment on property, hereafter referred to as the study area, proposed for bridge replacement or upgrading of bridge structure, and possible road realignment. Development outcome is still pending. The bridge is known as Bridge 0002, or the Riversdale Bridge.

Permission to access the study area and to conduct all activities associated with the Stage 1 archaeological assessment and property inspection was provided by the proponent. The area of the agricultural field is privately owned and aside from a walk across one field, the remainder of that portion of the study area, was not accessible for property inspection. The study area encompassed an area on either side of Bridge Street, east over the Riversdale Bridge, east into the adjacent agricultural field, and south to Highway 9, former Durham Road, and west to the edge of the Teeswater River, and north again, following the east bank of the river. This was the area subject to the Stage 1 archaeological assessment. The area of the river was wet foreshore and swampy areas slightly inland, some agricultural fields to the east, some wooded areas to the south, and marshy areas north of Highway 9. Sideroad 20 ran along the east side of the bridge, and Bridge Street ran east-west and supported the bridge structure. The study area (adjacent to bridge) is located on part of Lots 30 and 31, Concession 1 NDR, in the former geographic township of Greenock, now the Municipality of Brockton, Bruce County, formerly Saugeen County. The study area is 11.03 hectares in size.

The County of Bruce required an archaeological assessment for the proposed area to ensure there were no archaeological resources that might be impacted from the replacement or upgrading of the bridge or possible road realignment. The archaeological assessment was triggered by the Planning Act. There is no formal application for development at this time, and the Stage 1 assessment is being undertaken as due diligence on the part of the proponent.

A Stage 1 archaeological assessment was conducted by Scarlett Janusas Archaeology Inc. (Scarlett Janusas P027-0315-2017) in July 2017. The Stage 1 determined that archaeological potential existed for those areas that were not disturbed from bridge construction, bridge structure, roadways, roadway ditches, and areas not permanently wet (Teeswater River and immediate shoreline) and areas adjacent to the river, which were permanently wet.

The Stage 1 archaeological assessment indicated that there are no registered archaeological sites within one kilometer of the study area. There are no extant buildings on the property or immediately adjacent to the study area. A Pratt Truss bridge crosses the Teeswater on Bridge Street and is located within the study area.

There are no commemorative plaques located for the Riversdale area.

Soils are identified as primarily bottom land and muck. An area of agricultural field is identified as Toledo silt loam also with poor drainage.

The property visit verified that the topography of the project area is generally level but dropping towards the river and bottomlands, having a range in elevation of 270 to 274 m above sea level, the low lying areas being located closer to the Teeswater River. The Teeswater River crosses the study area towards the north end, and abuts the study area on its east bank from north to south.

A property visit was made to the site on July 6th, 2017 to confirm archaeological potential.

Based upon the background research of past and present conditions, and, the property visit, the following is recommended:

- Stage 2 archaeological assessment is required for this property, excluding areas of development disturbance and permanently wet areas. Stage 2 archaeological assessment must be conducted for those portions of the study area exhibiting archaeological potential. Stage 2 testing should consist of pedestrian transect methodology for areas ploughed in five metre intervals and for areas that cannot be ploughed, a test pitting methodology should be conducted, also in five metre intervals. Upon discovery of any archaeological materials/features, both methodologies should be intensified as per the Standards and Guidelines for Consulting Archaeologists in Ontario.
- Compliance legislation must be adhered to in the event of discovery of deeply buried cultural material or features.

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Project Personnel

Project Manager
Principal Archaeologist

Scarlett Janusas (P027)

Report Preparation

Scarlett Janusas (P027)

Field Director/Property Visit

Scarlett Janusas (P027)

Historic Research

Patrick Folkes

Graphics

Scarlett Janusas (P027)

**STAGE 1 ARCHAEOLOGICAL ASSESSMENT
PROPOSED BRIDGE REPLACEMENT OR UPGRADE
PART LOTS 30 AND 31, CONCESSION 1 NDR
GEOGRAPHIC TOWNSHIP OF GREENOCK
MUNICIPALITY OF BROCKTON
BRUCE COUNTY (FORMER SAUGEEN COUNTY)
ORIGINAL REPORT**

1.0 PROJECT CONTEXT

1.1 Development Context

The proponent retained the services of Scarlett Janusas Archaeology Inc. (SJA) to conduct a Stage 1 archaeological resource assessment on property, hereafter referred to as the study area, proposed for bridge replacement or upgrading of bridge structure, and possible road realignment. Development outcome is still pending. The bridge is known as Bridge 0002, or the Riversdale Bridge.

Permission to access the study area and to conduct all activities associated with the Stage 1 archaeological assessment and property inspection was provided by the proponent. The area of the agricultural field is privately owned and aside from a walk across one field, the remainder of that portion of the study area, was not accessible for property inspection. The study area encompassed an area on either side of Bridge Street, east over the Riversdale Bridge, east into the adjacent agricultural field, and south to Highway 9, former Durham Road, and west to the edge of the Teeswater River, and north again, following the east bank of the river. This was the area subject to the Stage 1 archaeological assessment. The area of the river was wet foreshore and swampy areas slightly inland, some agricultural fields to the east, some wooded areas to the south, and marshy areas north of Highway 9. Sideroad 20 ran along the east side of the bridge, and Bridge Street ran east-west and supported the bridge structure. The study area (adjacent to bridge) is located on part of Lots 30 and 31, Concession 1 NDR, in the former geographic township of Greenock, now the Municipality of Brockton, Bruce County, formerly Saugeen County. The study area is 11.03 hectares in size (Maps 1 – 4).

The County of Bruce required an archaeological assessment for the proposed area to ensure there were no archaeological resources that might be impacted from the replacement or upgrading of the bridge or possible road realignment. The archaeological assessment was triggered by the Planning Act. There is no formal application for development at this time, and the Stage 1 assessment is being undertaken as due diligence on the part of the proponent.

This archaeological assessment has been conducted under the 2011 Standards and Guidelines for Consultant Archaeologists (Ministry of Tourism, Culture and Sport, 2011).

1.2 Historical Context

1.2.1 Current Environment

The study area encompasses an area of 11.03 hectares. A Pratt truss bridge crosses the Teeswater River on Bridge Street at the north end of the study area. At the four corners of the bridge are areas that include the bridge abutments (poured concrete), the river and river shorelines. The study area extends back from the bridge about 20 metres in all directions. These areas are vegetated with wetland vegetation and trees with deep roots to withstand flooding.

To the east, the study area is an agricultural field (currently planted with soybean), that extends south towards Highway 9. Between the agricultural field and the highway are wooded areas. The river front is treed, and has components that are permanently wet.

The only structure in the study area is the Pratt truss bridge, although the study area abuts the concrete bridge on Highway 9 (it is not part of the study area).

1.2.2 Prehistory of Study Area

The Paleo period, 9500 – 8000 B.C., represents the first human populations in Ontario. These people subsisted largely on caribou and small mammals and fish. They were nomadic in nature, traveling large areas, but generally following glacial strandlines. Sites from this period are represented solely by lithic assemblages. There are no registered early or late Paleo Indian sites located on or in the vicinity of the study area.

The Archaic period spans a large time period from 7800 to 1000 B.C. Raw materials used by these nomadic people became much more diverse, and they remained hunters and gatherers. There are no registered archaeological sites identified as Early, Middle or Late Archaic periods.

The Woodland periods spans from 1000 B.C. to 1650 A.D. The introduction of ceramics marks the differentiation between the Woodland and Archaic periods. Woodland sites tended towards agricultural pursuits, which led to territorialism and warfare. There were still small sites during the Woodland period, often as outliers to agricultural fields, where the Indigenous populations would grow corn, tobacco, squash, etc. There are no registered Woodland sites located on or in the vicinity of the study area.

1.2.3 Indigenous Historic Period

The Indigenous Historic Period runs from circa 1700 to 1865. Both the Greenock

Swamp and the Teeswater River would have been a resource for Indigenous peoples for fall and winter hunting. This is documented following the 1836 “surrender” by both Brough and Johnston (Brough 1850; Johnston 1852: 8 – 11). In addition to the waterway providing a food resource, the use of the river as a transportation route would have existed prior to 1836, well into prehistory. It is expected that archaeological sites would be found close to the Teeswater River.

The Chippewas of Saugeen First Nation and the Chippewas of Nawash First Nation share the same traditional territories in southwestern Ontario. They were a part of the ancient Three Fires Confederacy of Ojibway, Odawa, and Pottawatomi. Prior to 1650, these groups inhabited the lands bordering on Lake Huron but after that year they moved westward to escape the Iroquois. After the defeat of the Iroquois, some Ojibway settled in the Saugeen Territory. [The route taken by the Three Fires to war with the Iroquois at the mouth of the Saugeen parallels the Lake Huron shoreline].

Throughout the eighteenth century the Saugeen Territory was inhabited by several generations of Ojibway whose immediate territory was threatened neither by war nor by European settlers. Some of these Ojibwa were the Wahbadicks, the Newashes, the Wahwahnosés, and the Metegwob who fished, trapped and hunted along the many rivers, streams and lakes of their lands (ibid: 2-9). It should also be noted that there were many “foreign” Indian settlements of the territory coming from the United States.

The Saugeen Ojibway Nation traditional territories cover the watersheds bounded by the Maitland River and the Nottawasaga River (east of Collingwood on Georgian Bay). The area includes all the Bruce Peninsula (which was once known as the Saugeen Peninsula), all of Grey and Bruce Counties, and parts of Huron, Dufferin, Wellington and Simcoe Counties.

There is a long history of occupation of the traditional lands by the SON and their ancestors. In 1836, there was a “surrender” of 1,500,000 acres (~607,028 hectares) according to Schmalz (1977:233), which included the subject lands (Maps 5 – 6).

To accommodate British and European immigration, officers of the Crown began their quest to secure lands from the Indigenous people toward the end of the 18th century. Large proportions of the Mississauga Tract along the northern shores of Lake Ontario had been obtained in 1792 and the bulk of the Huron Tract south of present day Bruce County in 1825. On August 9, 1836, after negotiations on Manitoulin Island between the chiefs of the Saugeen Ojibway and the Government of Upper Canada led by Sir Francis Bond Head, the Crown gained title to approximately 1.5 million acres (~607, 028 hectares) of Indigenous land along the shores of Lake Huron. The “Saugeen Tract Agreement” as it was called, was registered as Crown Treaty #45 ½ and include all of present day Bruce County save and except the peninsula area north of Southampton. Both treaties provided for reserve areas for the Ojibwa, one of which is the current Saugeen Reserve adjacent to present day Southampton.

1.2.4 Historic Métis

The Historic Saugeen Métis are descendants of the Métis who traded at Saugeen. Pierre Piché was considered this first Métis in the area, trading in about 1816. The Ojibwa invited Piché to share the resources within the Saugeen territory, but also required him to “share” in the protection of these same resources and the environment for mutual benefit.

“In 1816-1818, Wampum, strings of bead, was presented to Piché as a tangible reminder, an enduring record, of the historic diplomatic exchange, and the words spoken between the Ojibwe and Métis, that formed their peaceful and sharing relationship in the Saugeen territory”
(<http://www.saugeenmetis.com/main.php?page=heritage>).

The Historic Saugeen Métis are descended from unions between European traders and Indigenous women. The Lake Huron watershed Métis “lived, fished, hunted, trapped and harvested the lands and waters of the Bruce Peninsula, the Lake Huron proper shoreline and its watershed. These are considered the traditional Métis territory.

The contemporary Métis community extends for 275 kms of Lake Huron shoreline from Tobermory to south of Goderich, and includes the counties of Bruce, Grey and Huron.

During the late 1700s, the Jesuit Fathers established two missions in Bruce County with the mission of St. Peter and St. Paul believing to have been near present day Southampton. Soon after the arrival of the Jesuit Fathers, fur traders began moving into the area. In the early part of the 19th century, a series of fur trading posts were established at Saugeen, now rendering unnecessary the long difficult trips to Quebec and Montreal carrying hundreds of fur pelts for trade with the French. In 1818, Metis fur trader Pierre Picher came from Lower Canada to Fort Michilimackinac where he learned of the abundance of fur-bearing animals at the mouth of the Saugeen and traveled there to establish a trading post. He built a house and store on the south side of the river and married an Ojibwa woman with whom he had a family. In the face of much competition, Picher held control of much of the fur trade in the Saugeen area. After his premature death in 1828, his business was taken over by a succession of other French or Metis traders such as Edward Sayers, Achille Cadot and one Adelaide Lamorandiere who stayed at Saugeen until the outbreak of the Rebellion of 1837. The fur trade at Saugeen became even more intense when, sometime between 1822 and 1826, the Hudson’s Bay Company established a post there known as “Saguingue”. The post remained open until 1832 when it was closed due to the decreasing number of bear in the area as well as a lack of interest on the part of the Ojibwa, many of whom were now devoting themselves to the Missionary Society of the Methodist Episcopal Church who had set up a mission at Saugeen in 1831.

As the study area is removed from the Lake Huron shoreline, there is a low probability that Historic Métis sites will be found in this location.

1.2.5 Euro-Canadian Historic Period

Unlike other areas of Upper Canada surrendered by the Indigenous people to the Crown, the Saugeen Tract was not immediately assigned to a district under the new system of geographic division set up after the proclamation of 1788. While the land immediately to the south was assigned to either the Huron or Wellington District, the Saugeen lands became an area of unknown designation referred to simply as the “Queen’s Bush”. In order to provide for the administration of justice, Act of Parliament (9 Vic, Ch. 47) was passed May 23, 1846 as follows:

That portion of the province lying to the northward of the District of Huron, bounded on the north by Lake Huron and the Georgian Bay, which is not included in either of the Districts of Wellington or Simcoe (which) is declared, for all purposes of and connected with the administration of justice, civil and criminal, to form part of the District of Huron.

In 1848, efforts were made to have this territory included in a new county with Owen Sound as the seat but the idea was turned down. Finally, on May 30, 1849, Act of Parliament (12 Vic., Ch. 96) divided the Huron District, including the judicial “Queen’s Bush” into the three new counties of Huron, Perth and Bruce. The new county was named for James Bruce, Earl of Elgin and Kincardine, who at that time was the Governor-General of Canada. The first session of a new county council was held January 28, 1850 at Goderich where the new clerk and warden were appointed. Surveys began shortly thereafter for the townships that would make up the new County of Bruce.

Greenock Township was considered to have more “inferior” land than any other township in Bruce County south of the Bruce Peninsula. The Mud River (the Teeswater River) was known to have only small banks along its course, and flooded regularly in the spring from a metre to a metre and a half. The average price of an acre in 1879 was \$22.60 (Robertson 1960: 401). The presence of the Greenock Swamp prohibited travel and settlement of large parts of the township. In fact, Greenock Township was the last to be surveyed in Bruce County. The township was surveyed by R. Walsh, P.L.S. in 1852. “Free lands” were confined to those one lot on either side of the Durham Road (Highway 9). First settlers in Greenock Township included Joseph Chartrand and John Caskanette, who had actually been staff used by Walsh during this survey of the township. They each took up land in what would become Riversdale, which was positioned well by crossing the Teeswater River, where it crossed the Durham Road.

The Riversdale post office was established in 1853 or 1854, and George Cromar was the postmaster. The lots for the village were surveyed in 1855 (<http://www.rootsweb.ancestry.com/~onbcgs/bcgstwpgreenock.htm>). Riversdale also had the nickname of Mud River, from the Teeswater River, a muddy river.

There was also a steam saw and grist mill run by George Cromar in 1857 (Robertson 1960: 405). The mills were rented from Cromar in 1860 by James Millar and Anthony

Mason. Following Cromar's death, they were able to purchase the mills from the executors of the estate. Robertson indicates that these mills had burned at least five or six times (ibid: 408). It should be noted that while Robertson indicates the mills, the exact location of these is not noted. Based on the specific lot history, although there was a lot in reserve for a steam mill, there is no archival documentation to support the actual existence of a mill in this location.

The mill run by James Millar and Anthony Mason is listed in the 1871 census, under the general heading of Greenock. The mill operated 12 months a year, had seven employees, processed pine and hemlock into boards, shingles and lath. While Millar is listed in Schedule 1, Return of the Living, but there is no location in the subsequent schedules for Millar, so it is not possible to say he was living in the township. There is no entry for "Antony Mason" in Greenock at all. It is possible that this mill was located elsewhere in the township. There was no physical evidence above grade or found in the test pitting of the area of any sawdust, slab wood, or coal and cinder remnants.

As noted above, George Cromar, held many positions in Riversdale. He continued to be a prominent leader in the community until his death in 1861.

1.2.5.1 Specific Lot History: Lots 30 and 31, Concession 1 NDR

The Crown patent to Lot 30 (50 acres) (~20 hectares) was issued to George Cromar on August 26th, 1856. Even before the patent was issued, Cromar was in occupation and with the intention of development a village, he had the site of what became Riversdale surveyed (Kertland 1856). The Plan (Map 7), which is dated January 20th, 1856, shows a bridge across the Teeswater River at the foot of Bridge Street. On the south side of Bridge Street and adjacent to the river, there was a designated a "Reserve for Steam Mills" of 3.5 acres (~1.4 hectares). Based on the entries in the Abstract Land Index, there appears to have been no actual mill development on the property, perhaps because Cromar died in 1861. His executors sold the acreage on October 15th, 1862 to James Millar. It passed to John Alexander in January of 1866, then to James Johnston in April of 1877, but was still in Alexander's name apparently because of some legal difficulty. Lorne Hardie bought the property from Alexander on April 3rd, 1884, and sold it to Andrew Kempel on October 13th, 1902. It remained in the Kempel family into the 1950s.

North of Bridge Street, beside the river, is an unnumbered lot, described in the "Index" as "the Lot lying between Lot 116 & the Teeswater". As part of Cromar's village plot, it was sold on December 16th, 1859 to Ninian [spelling?] Woods. No additional transactions are recorded until April of 1905, when the trustees of the Riversdale Presbyterian Church entered a deed to the property in the name of Charles Seymour. It next appears in 1944 when, on December 1st, Andre and Eugenia Freiburger sold it to Cyril Kempel, a member of the family associated with the ownership of the steam mill reserve. There is no evidence, however, in the archival record that this steam mill operated in the study area. Map 8 illustrates the 1880 map section of Riversdale.

Lots 114-116, fronting Bridge Street and nearest the village lots to the bridge across the Teeswater, share a similar historical sequence as that part of their unnumbered neighbour. All three lots were sold by Cromar to Woods in December of 1859. Because of unpaid taxes, they were sold by “tax deed” by the County of Bruce to Thomas Rookledge in February 1875. They are next recorded in the “Land Index” in April of 1905, being then disposed of to Charles Seymour by the Presbyterian Church trustees. Seymour’s widow sold the lots to Pete Valad in April of 1919, and they remained in the possession of the Valad family through the 1930’s, eventually being acquired the following decade by the Kempels.

The nature of the bridge indicated on the map of 1856 is unknown, that is, it may have been a wooden bridge, an early iron bridge, etc. It may have been a structure in 1892, then known as “Cromar’s bridge”, and being 124 feet (~38 metres) in length (Road and Bridge Committee 1892: 31). Or there may have been successors between 1856 and 1892. The latter was probably replaced in the twentieth century, perhaps as early as 1905, by a 125-foot (~38 metres) “riveted Pratt truss steel bridge” constructed by the Hunter Bridge & Boiler Company (Gateman 1981: 96).

1.2.6 Plaques or Monuments

There are no plaques or monuments in the Riversdale area (Ontario Heritage Trust online plaque guide, accessed July 9, 2017).

1.2.7 Determination of Archaeological Potential

There are a number of variables that are evaluated when determining archaeological potential. These include:

- presence of previously identified archaeological sites,
- water sources (primary, secondary, features indicating past water sources, accessible or inaccessible shoreline),
- elevated topography,
- pockets of sandy soil in heavy soil or rocky ground,
- distinctive land formations,
- resource areas (food or medicinal plants, scarce raw materials, early Euro-Canadian industry),
- non-Aboriginal settlement (monuments, cemeteries),
- areas of early Euro-Canadian settlement;
- early historic transportation routes;
- listed or designated heritage property;
- and properties with archaeological potential as identified by local histories or informants.

1.2.8 Rationale for Fieldwork Strategy

The study area exhibits archaeological potential based on the study area abutting the Teeswater River, the proximity of the Durham Road - an early transportation corridor; the early (mid-1850's) village of Riversdale; and, the use of the river by Indigenous populations for both transportation and resource exploitation. Areas of low potential include those of permanently wet areas, and the poor drainage of the area from mud, bottom land, and other poorly drained soils. Included in the area of low potential is Bridge Street, Sideroad 20 and the bridge structure impacting the environment with the construction of the bridge abutments. The bridge is also a potential indicator of early historic activities (bridge construction) in the area.

A property visit was conducted to confirm archaeological potential of the study area. Only portions of the property could be accessed: 1) along Bridge Street and into the adjacent agricultural field 2) and the area facing north from Highway 9. A walk was made into the agricultural field, and along Bridge Street. Access from the Highway 9 was not possible, although a walk was conducted along the Highway at the south end of the study area and to the concrete bridge passing over the Teeswater to view the study area facing north. From a distance (roadside), it could be seen that the area of woods along Highway 9 contained standing water. The images taken unfortunately were unable to capture the standing water as there were too many trees and low lying vegetation obscuring the water. Along the riverfront, there was no discernable river bank, and those immediate areas were also permanently wet.

Given that the village of Riversdale occupies only the west bank of the Teeswater River, its development of only one side of the river is testimony to the fact that the east side is not accessible for development because of water issues.

In addition, permission was not provided for the agricultural fields on the east side of the study area. Access to these areas for the property visit were confined to a photograph of the agricultural field facing southwards, and facing northwards from the highway. Therefore the property inspection was used in combination with topographic and satellite maps to determine archaeological potential.

1.3 Archaeological Context

1.3.1 Previously Known Archaeological Resources/Assessments

There are no registered archaeological sites within one kilometre of the study area (PastPortal 2017), however, this is a reflection of lack of archaeological survey and investigation in this area, rather than as an indicator of verified lack of archaeological sites in the area.

There are no completed archaeological assessments within 50 metres of the study area.

1.3.2 Current Environment – Existing Features

The study area is over 11 hectares in size, much of it bordering the Teeswater River on the east side of the river, and at Bridge Street, touching both sides of the Teeswater River. A Pratt truss steel bridge crosses the river along Bridge Street. The abutments of the bridge were located adjacent to the river and were poured concrete. The study area is bounded to the south by the Durham Road, known as Highway 9. Bridge Street passes through the property at the north end is an elevated roadway in this area.

1.3.3 Physiography, Bedrock and Topography

The underlying bedrock of the study area is limestone, dolostone, shale of the Detroit River Group, Onondaga formation (Ontario Geological Survey 2011). The study area lies in the physiographic region known as the Horseshoe Moraines (Chapman and Putnam 1973). The study area has an elevation ranging from of 270 to 274 metres above sea level.

1.3.4 Prehistoric Shorelines

There are no prehistoric shorelines located near the study area.

1.3.5 Soils

Soils of the study area (Map 9) are three types: bottom-land, muck and Toledo silt loam. Bottom-land soils have variable drainage and are low lying lands along stream, or in this case, river courses. Muck is poorly drained, with black, well decomposed organic soils of varying depths over sand, clay and mud. Toledo silt loam is poorly drained, about 7" (~18 cms) of very dark grey silt loam or clay loam over drab grey mottled materials with poorly defined horizons (and muck are poorly drained, as is Toledo silt loam (Hoffman and Richards 1954).

1.3.6 Drainage

The Teeswater River is part of the Saugeen watershed. The Teeswater River is a tributary of the Saugeen River, and has been called *Ah-shushki-sebi* or the Muddy or Mud River (Brough 1850). It is crossed by the Riverside Bridge, or Bridge 0002. The river abuts the study area primarily on the east side, and touches both side of the river at the north end of the study area.

To the south of the study area is Kinlough Creek. The study area was once part of the much larger (large areas have been drained) of the Greenock Swamp.

1.3.7 Vegetation

The study area is vegetated with trees with extensive root systems able to withstand flooding, lush grasses, sedges, cattails and other wetland species.

1.3.8 Dates of Fieldwork

The Stage 1 property visit was conducted on July 6th, 2017 under sunny skies with a high of 28 degrees Celsius.

As per the Ministry of Tourism, Culture and Sports' Standards and Guidelines (2011: Section 2.1, Standard 3) the fieldwork was conducted under the appropriate lighting and weather conditions.

1.3.9 Unusual Physical Features Affecting Fieldwork

Permission was not provided to access the agricultural fields on the east side of the study area as these are privately owned. Property inspection was limited to those areas that could be accessed. In addition, observations along the east bank of the river were limited to those taken from the bridges at both the north and south ends of the study area.

2.0 FIELD METHODOLOGY

2.1 Stage 1 (Background Research)

As part of the background research, an examination of the following was conducted:

- the Site Registration Database (maintained by the Ontario Ministry of Tourism, Culture and Sport) was examined for the presence of known archaeological sites in the project area and within a radius of one kilometer of the project area by contacting the data coordinator of the Ministry of Tourism and Culture;
- reports of previous archaeological fieldwork within a radius of 50 m around the property;
- topographic maps at 1:10 000 (recent and historical) or the most detailed map available;
- historic settlement maps such as the historic atlases;
- available archaeological management/master plans or archaeological potential mapping;
- commemorative plaques or monuments; and,
- any other avenues that assist in determining archaeological potential were examined.

The following table identifies the standards and guidelines within the Ministry of Tourism, Culture and Sport Standards and Guidelines document (2011) and how they were met with respect to the Stage 1 background study.

| MTCS Standard | Comment |
|---|--|
| <ul style="list-style-type: none"> • The most up-to-date (as of the date of submission of the Project Information Form) listing of sites from the Ministry of Tourism, Culture and Sport's archaeological sites database for a radius of 1 km around the property | Done – no registered archaeological sites |
| <ul style="list-style-type: none"> • Reports of previous archaeological field work within a radius of 50 m around the property | Done – none |
| <ul style="list-style-type: none"> • Topographic maps at 1:10,000 (recent and historical) or the most detailed scale available | Done – see maps |
| <ul style="list-style-type: none"> • Historic settlement maps (e.g., historical atlas) | Done – see maps |
| <ul style="list-style-type: none"> • When available, archaeological management plans or other archaeological potential mapping | Not Applicable, no archaeological master plan for Bruce County |
| <ul style="list-style-type: none"> • Commemorative plaques or monuments | Done - no plaques |

Maps 1-4 illustrate the location of the study area. No formal plan for the proposed development of the property exists at this time, as results of this assessment and other studies will assist in development strategy. Map 11 illustrates the images of the study area (Images 1 - 11), Map 10 illustrates the archaeological potential of the property.

Approximately 84.3% of the study area exhibits archaeological potential. Stage 2 archaeological assessment is recommended for those areas with potential.

2.2 Stage 1 Property Visit

Stage 1 property visit was conducted by Scarlett Janusas Archaeology Inc. (P027-0315-2017) on July 6th, 2017. Permission was not provided to access the agricultural fields on the east side of the study area as these are privately owned. Property inspection was limited to those areas that could be accessed. In addition, observations along the east bank of the river were limited to those taken from the bridges at both the north and south ends of the study area.

Therefore the property inspection was used in combination with topographic and satellite maps to determine archaeological potential.

Images 1 – 11 illustrate the study area.

3.0 RESULTS

3.0 Stage 1 Archaeological Assessment

The Stage 1 archaeological assessment indicated that the study area exhibited archaeological potential based on proximity to the Teeswater River, Kinlough Creek and marshy area; the proximity of an historic transportation route; the relatively undeveloped area (aside from bridge and roadway), and, the use of the Teeswater River by Indigenous peoples as both a transportation system and a resource for exploitation of fish, wildlife and plants.

Approximately 84.3% of the study area exhibits archaeological potential. Stage 2 archaeological assessment is recommended for those areas with potential (Map 10).

4.0 ANALYSIS AND CONCLUSIONS

Approximately 84.3% of the study area was considered to exhibit archaeological potential. Roads, bridges, and deep ditches associated with road construction accounted for disturbed areas of no potential (5.5%). Another 10.2% of the study area consisted of the Teeswater River and permanently wet areas (marshy wetlands).

Based on Section 2.2 of the Standards and Guidelines, further archaeological assessment is required for this property.

5.0 RECOMMENDATIONS

Based upon the background research of past and present conditions, and, the property visit, the following is recommended:

- Stage 2 archaeological assessment is required for this property, excluding areas of development disturbance and permanently wet areas. Stage 2 archaeological assessment be conducted for those portions of the study area exhibiting archaeological potential. Stage 2 testing should consist of pedestrian transect methodology for areas ploughed in five metre intervals and for areas that cannot be ploughed, a test pitting methodology should be conducted, also in five metre intervals. Upon discovery of any archaeological materials/features, both methodologies should be intensified as per the Standards and Guidelines for Consulting Archaeologists in Ontario.
- Compliance legislation must be adhered to in the event of discovery of deeply buried cultural material or features.

6.0 ADVICE ON COMPLIANCE WITH LEGISLATION

According to the 2011 Standards and Guidelines (Section 7.5.9) the following must be stated within this report:

This report is submitted to the Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

It is an offence under Sections 48 and 69 of the Ontario Heritage Act for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the Ontario Heritage Act.

Should previously undocumented archaeological resources be discovered, they may be an archaeological site and therefore subject to Section 48 (1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the Ontario Heritage Act.

The Cemeteries Act, R.S.O. 1990 c. C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the Ontario Heritage Act and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

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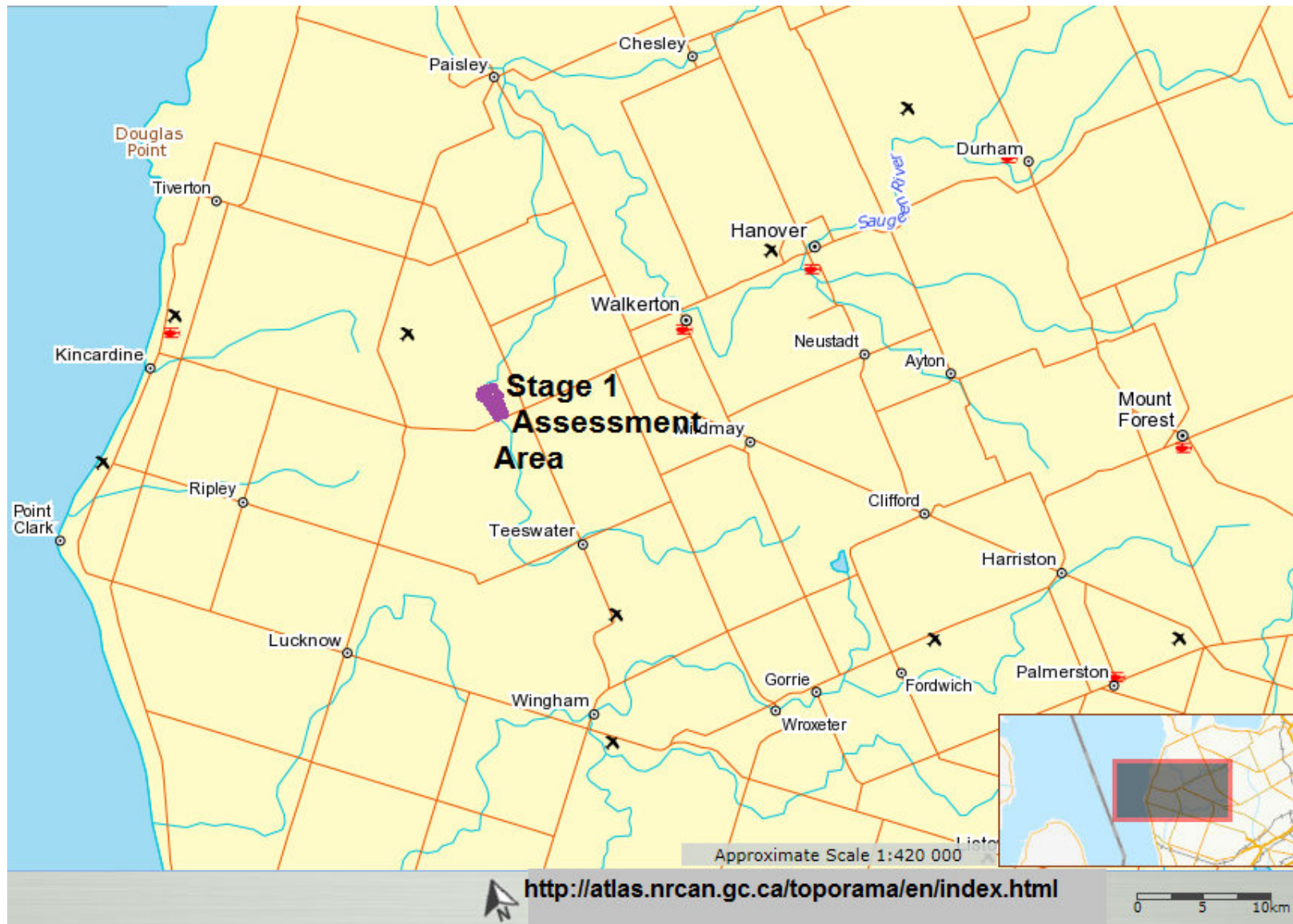
Bruce County Interactive Mapping
www.Brucecounty.on.ca/map

Topographic Mapping
www.atlas.nrcan.gc.ca

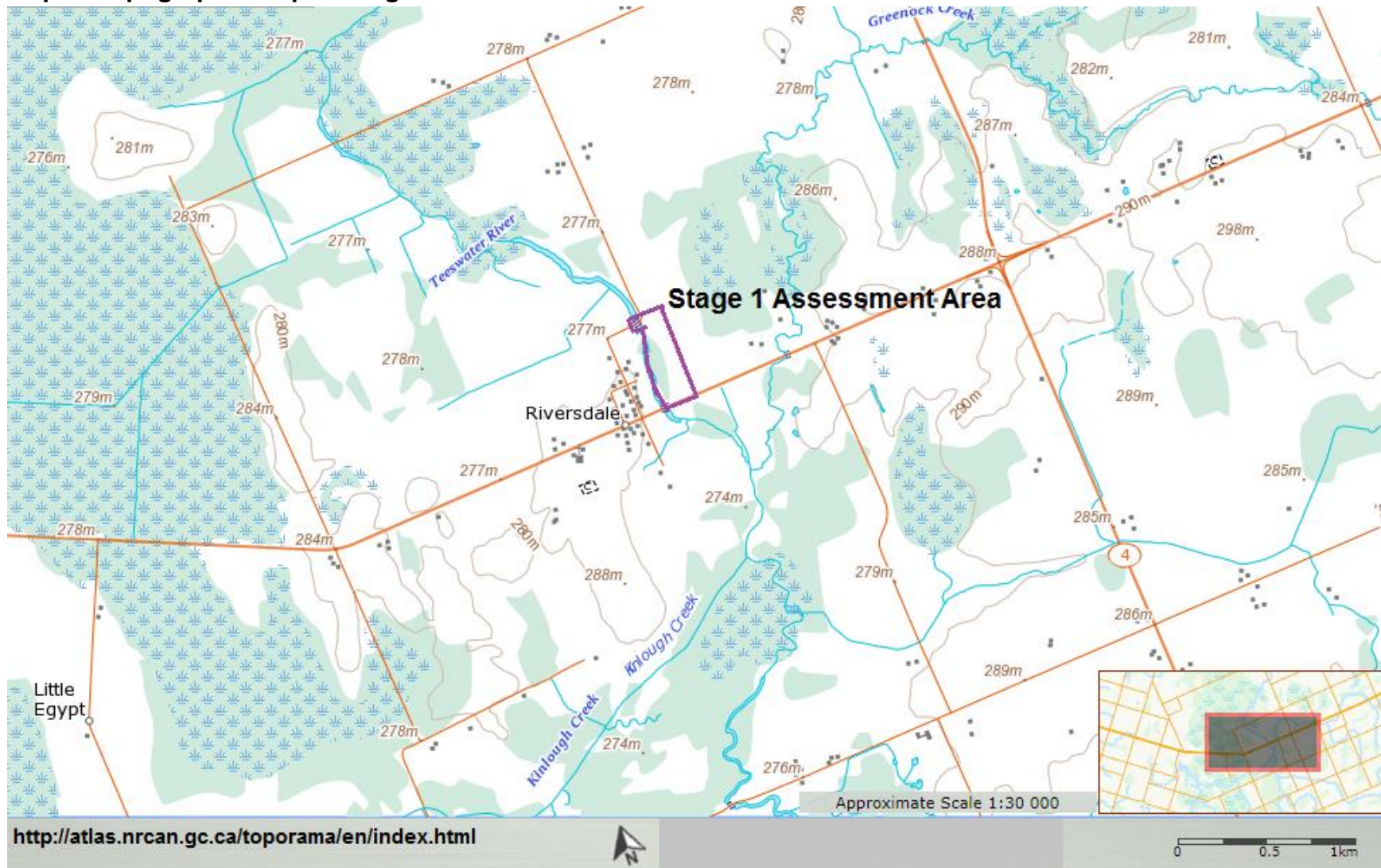
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Map 2: Regional Location of Study Area

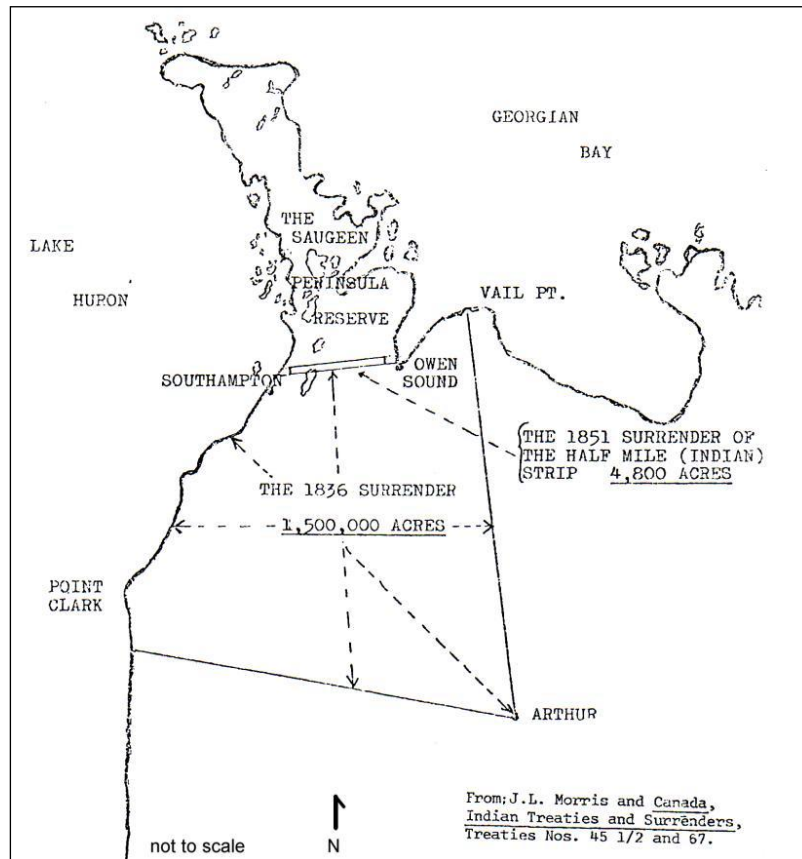
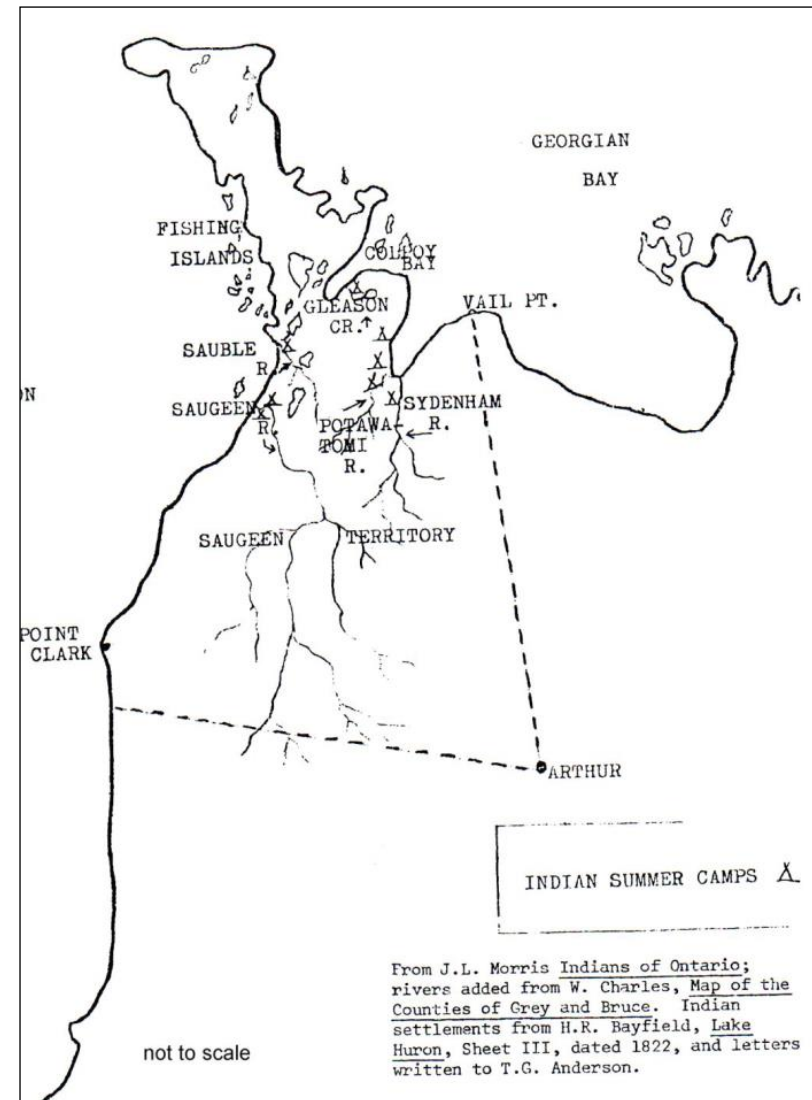


Map 3: Topographic Map of Stage 1 Assessment Area

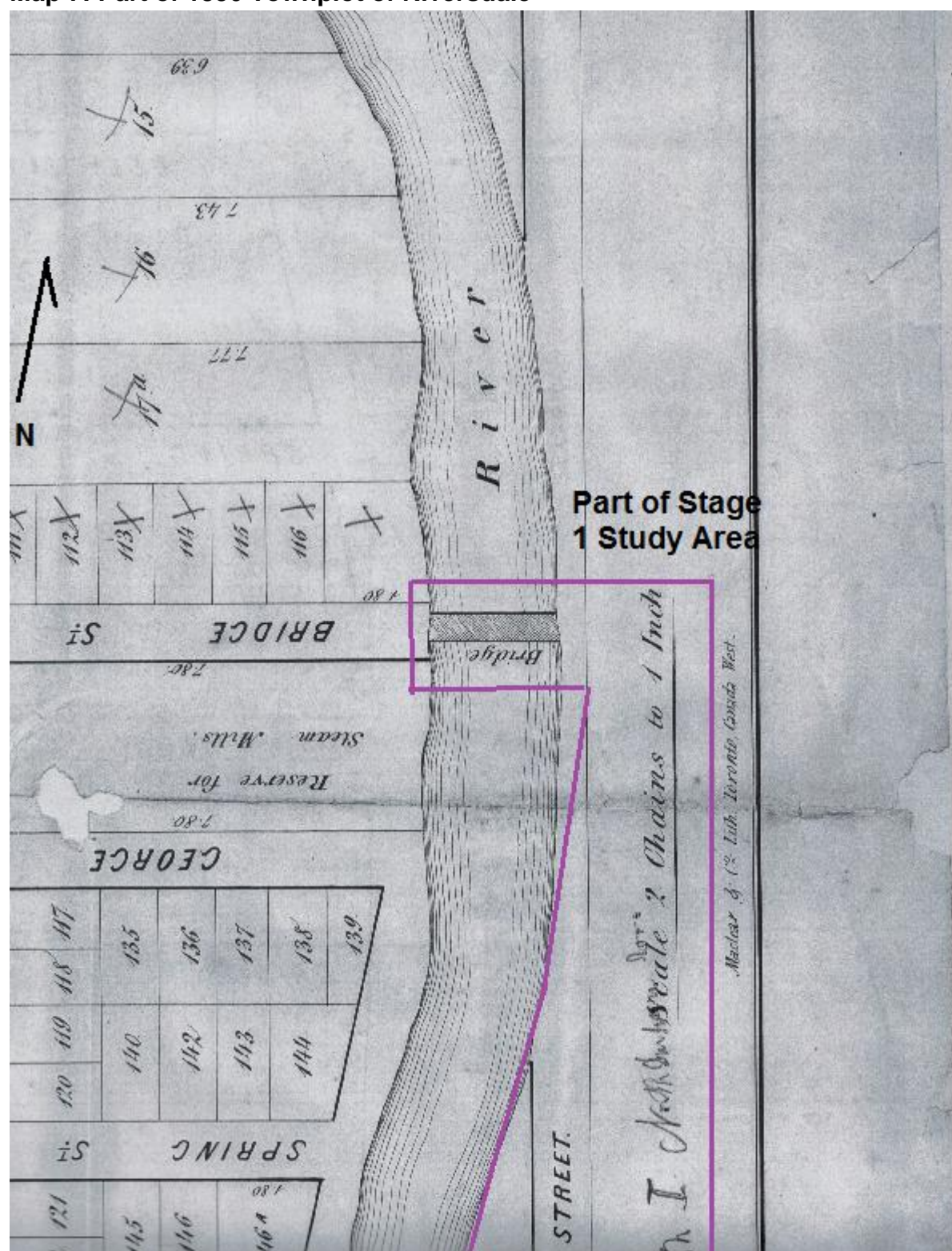


Map 2: Stage 1 Study Area

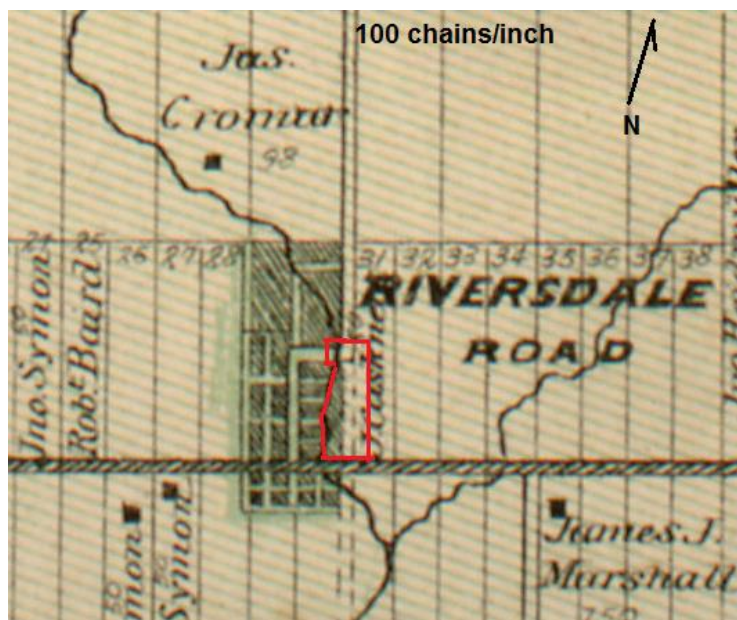


Map 3: 1836 Surrender (Schmalz 1977:233)**Map 4: Saugeen Lands Before Surrender (Schmalz 1977)**

Map 7: Part of 1856 Townplot of Riversdale

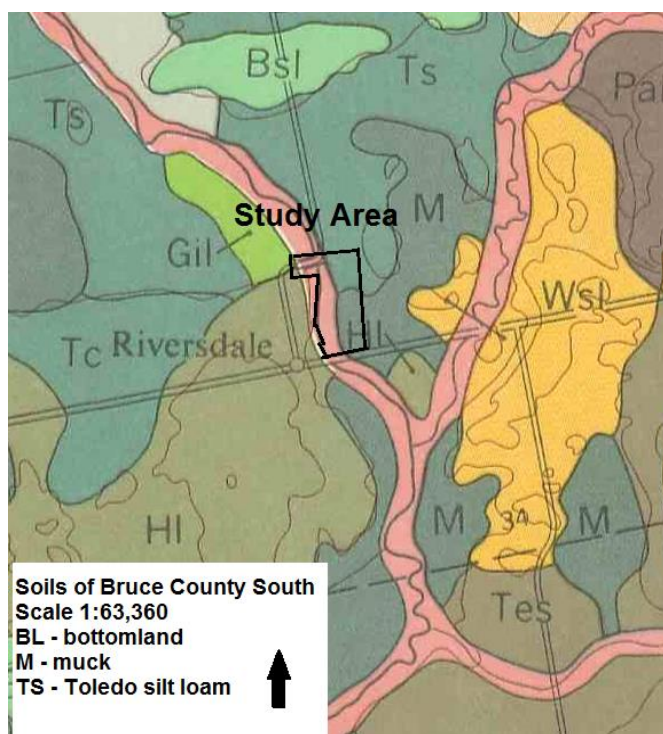


Map 8: 1880 Illustrated Historic Atlas Map Section (Belden & Co.)

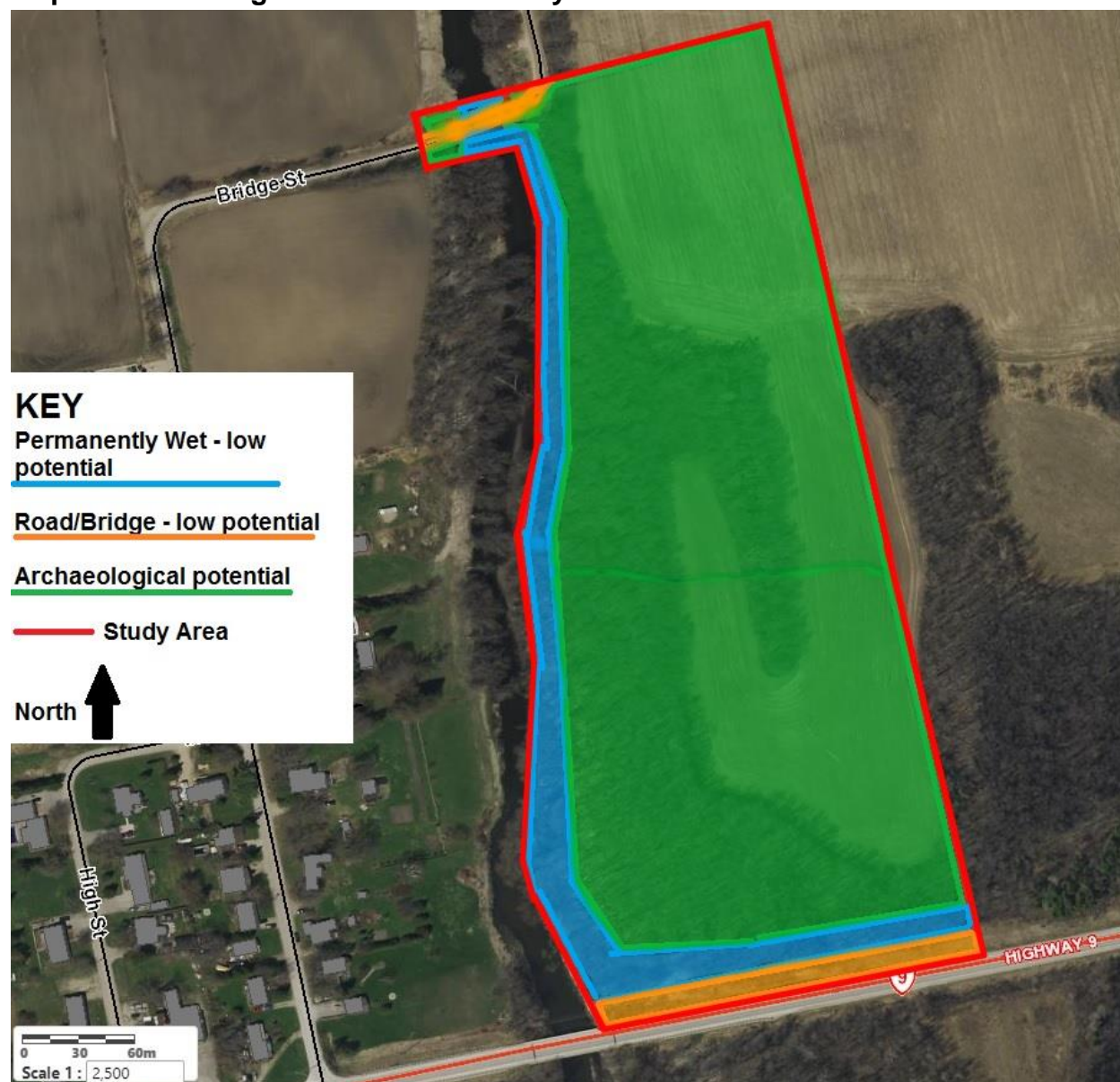


Map 5: Soils of Study Area

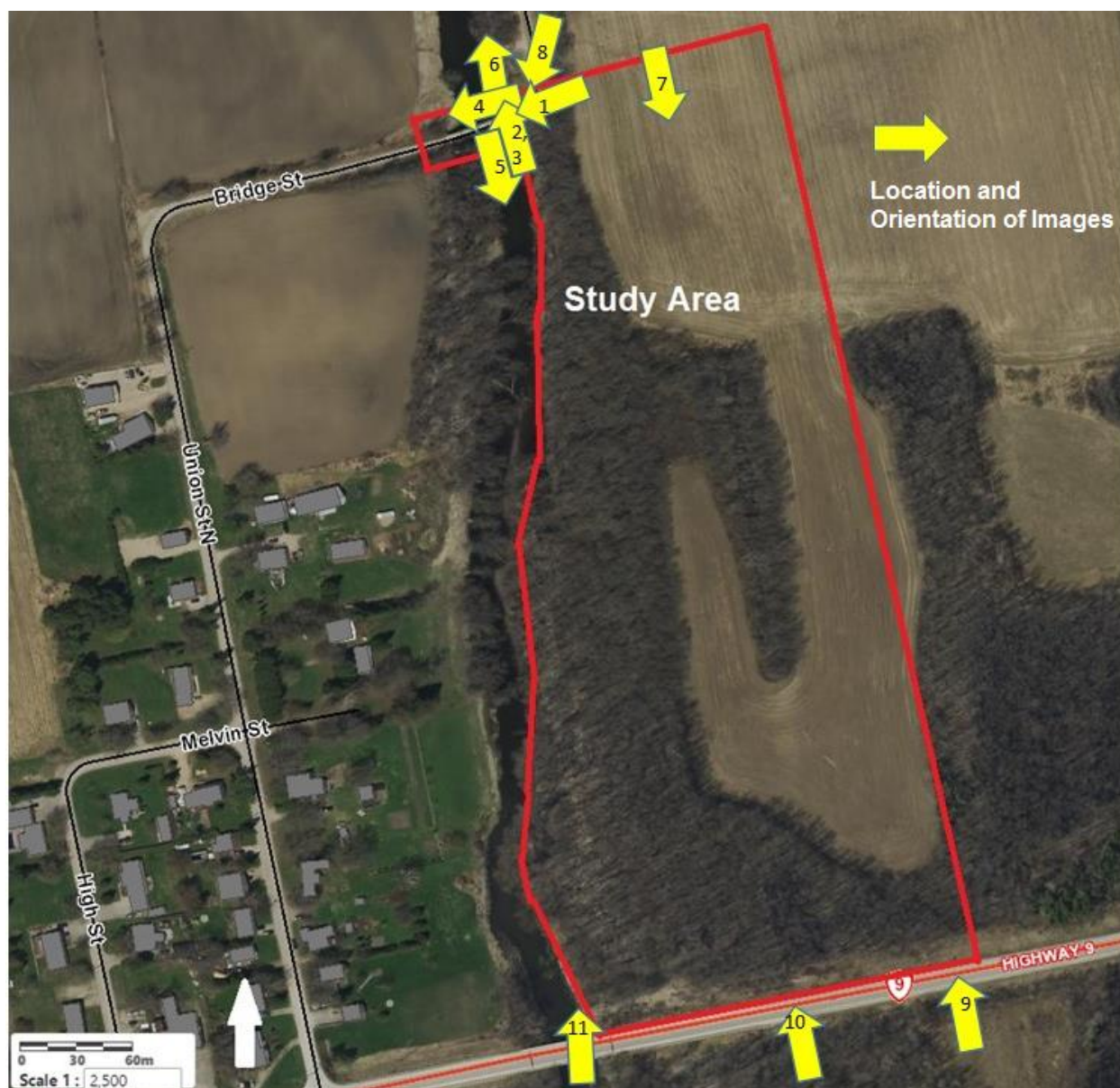
(<http://sis.agr.gc.ca/cansis/publications/surveys/on/on16/index.html>)



Map 6: Archaeological Potential of Study Area



Map 11: Location and Direction of Images



IMAGES

Image 1: Riversdale Bridge facing SW



Image 2: Northeast Bridge Corner facing NW



Image 3: Northeast Bridge Corner facing NW



Image 4: Northwest Corner of Study Area facing SW



Image 5: River Banks facing SE



Image 6: River Banks facing NW



Image 7: Agricultural Fields facing SE



Image 10: Facing NNE at South End



Image 8: Study Area facing SW



Image 11: Facing N at Southwest End



Image 9: Facing NNE at SE End



**STAGE 2 ARCHAEOLOGICAL ASSESSMENT
PROPOSED BRIDGE REPLACEMENT OR UPGRADE
PART LOTS 30 AND 31, CONCESSION 1 NDR
GEOGRAPHIC TOWNSHIP OF GREENOCK
MUNICIPALITY OF BROCKTON
BRUCE COUNTY (FORMER SAUGEEN COUNTY)
ORIGINAL REPORT**

Prepared for:

**County of Bruce
and
Ministry of Tourism, Culture and Sport**

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**License # P027, PIF #P027-0317-2017
July 11, 2017**

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Executive Summary

The proponent retained the services of Scarlett Janusas Archaeology Inc. (SJA) to conduct a Stage 2 archaeological resource assessment on property proposed for bridge replacement or upgrading of bridge structure. Development outcome is still pending. The bridge is known as Bridge 0002, or the Riversdale Bridge.

Permission to access the property, hereafter known as the study area, and to conduct all activities associated with the Stage 2 archaeological assessment was provided by the proponent. The areas on either side of the bridge and Teeswater River were the subject of the archaeological assessment. All areas, northwest, northeast, southeast and southwest of the bridge, were all adjacent river wooded vegetation. Sideroad 20 ran along the east side of the bridge, and Bridge Street ran east-west and supported the bridge structure. The study area (adjacent to bridge) is located on part of Lots 30 and 31, Concession 1 NDR, in the former geographic township of Greenock, now the Municipality of Brockton, Bruce County, formerly Saugeen County. The study areas subject to Stage 2 archaeological assessment, combined, measured 1,600 m².

The County of Bruce required an archaeological assessment for the area immediately around the existing bridge to ensure there were no archaeological resources that might be impacted from either the replacement or upgrading of the bridge. The archaeological assessment was triggered by the Planning Act. The client is conducting due diligence in regards to this area prior to a development application.

A Stage 1 archaeological assessment was conducted by Scarlett Janusas (P027-0315-2017) for a larger study area that included the Stage 2 study area. The Stage 1 determined that archaeological potential existed for those areas that were not disturbed from bridge construction and actual bridge and roadways, and areas not permanently wet (Teeswater River) and areas adjacent to the river, which were permanently wet. The Stage 1 archaeological assessment indicated that there are no registered archaeological sites within one kilometer of the study area. There are no extant buildings on the study area or immediately adjacent to the study area. A Pratt Truss bridge crosses the Teeswater on Bridge Street and is located within the study area.

The Stage 2 archaeological assessment of the study area was conducted under license P027 (Scarlett Janusas, PIF #P027-0317-2017) on July 6th, 2017 under good assessment weather conditions. No archaeological materials or features were located during the assessment.

Based upon the background research of past and present conditions, and the archaeological assessment, the following is recommended:

- No further archaeological assessment is required for the study area.

- Compliance legislation must be adhered to in the event of discovery of deeply buried cultural material or features.

This archaeological assessment has been conducted under the 2011 Standards and Guidelines for Consultant Archaeologists (Ministry of Tourism, Culture and Sport, 2011).

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Project Personnel

| | |
|-----------------------------------|---|
| Project Manager Field Director | Scarlett Janusas (P027) |
| Report Preparation | Scarlett Janusas (P027) |
| Field Crew | Pete Demarte (R1073) Chelsea Robert (R403) |
| Graphics | Scarlett Janusas (P027) |

**STAGE 2 ARCHAEOLOGICAL ASSESSMENT
PROPOSED BRIDGE REPLACEMENT OR UPGRADE
PART LOTS 30 AND 31, CONCESSION 1 NDR
GEOGRAPHIC TOWNSHIP OF GREENOCK
MUNICIPALITY OF BROCKTON
BRUCE COUNTY (FORMER SAUGEEN COUNTY)
ORIGINAL REPORT**

1.0 PROJECT CONTEXT

1.1 Development Context

The proponent retained the services of Scarlett Janusas Archaeology Inc. (SJA) to conduct a Stage 2 archaeological resource assessment on property proposed for bridge replacement or upgrading of bridge structure. Development outcome is still pending. The bridge is known as Bridge 0002, or the Riversdale Bridge.

Permission to access the property, hereafter known as the study area, and to conduct all activities associated with the Stage 2 archaeological assessment was provided by the proponent. The areas on either side of the bridge and Teeswater River were the subject of the archaeological assessment. All areas, northwest, northeast, southeast and southwest of the bridge, were all adjacent river wooded vegetation. Sideroad 20 ran along the east side of the bridge, and Bridge Street ran east-west and supported the bridge structure. The study area (adjacent to bridge) is located on part of Lots 30 and 31, Concession 1 NDR, in the former geographic township of Greenock, now the Municipality of Brockton, Bruce County, formerly Saugeen County. The study areas subject to Stage 2 archaeological assessment, combined, measured 1,600 m² (Maps 1 – 4).

The County of Bruce required an archaeological assessment for the area immediately around the existing bridge to ensure there were no archaeological resources that might be impacted from either the replacement or upgrading of the bridge. The archaeological assessment was triggered by the Planning Act. The client is conducting due diligence in regards to this area prior to a development application.

This archaeological assessment has been conducted under the 2011 Standards and Guidelines for Consultant Archaeologists (Ministry of Tourism, Culture and Sport, 2011).

1.2 Historical Context

1.2.1 Current Environment

The study area (20 m by 20 m areas located northwest, northeast, southwest and southeast of the bridge structure) measured a combined area of 1,600 m².

A Stage 1 archaeological assessment was conducted by Scarlett Janusas (P027-0315-2017) for a larger study area that included the Stage 2 study area. The Stage 1 determined that archaeological potential existed for those areas that were not disturbed from bridge construction and actual bridge and roadways, and areas not permanently wet (Teeswater River) and areas adjacent to the river, which were permanently wet. The Stage 1 archaeological assessment indicated that there are no registered archaeological sites within one kilometer of the study area. There are no extant buildings on the study area or immediately adjacent to the study area. A Pratt Truss bridge crosses the Teeswater on Bridge Street and is located within the study area.

The study area abuts the Teeswater River, and is vegetated with wetland species, trees, etc.

1.2.2 Summary of Stage 1 Land Use History

The Stage 1 archaeological assessment report included both archival research and a property visit. The background research indicated that the area of the Stage 2 assessment (the subject of this report) was bisected by the Teeswater River, the Pratt Truss bridge and Bridge Street. Areas adjacent to the Teeswater River were deemed to be permanently wet areas – the river noted for having little to no banks. Soils were bottomland and muck, with a small area of Toledo silt. All three soils types had poor drainage. Elevation rose from the river, from 270 to 274 metres. There were no prehistoric shorelines in the vicinity, no registered archaeological sites, or archaeological assessments (within 50 metres of the study area).

The specific lot history indicated the following (Scarlett Janusas Archaeology Inc. 2017: Section 1.2.5.1):

“The Crown patent to Lot 30 (50 acres) (~20 hectares) was issued to George Cromar on August 26th, 1856. Even before the patent was issued, Cromar was in occupation and with the intention of development a village, he had the site of what became Riversdale surveyed (Kertland 1856). The Plan, which is dated January 20th, 1856, shows a bridge across the Teeswater River at the foot of Bridge Street. On the south side of Bridge Street and adjacent to the river, there was a designated a “Reserve for Steam Mills” of 3.5 acres (~1.4 hectares). Based on the entries in the Abstract Land Index, there appears to have been no actual mill development on the property, perhaps because Cromar died in 1861.

His executors sold the acreage on October 15th, 1862 to James Millar. It passed to John Alexander in January of 1866, then to James Johnston in April of 1877, but was still in Alexander's name apparently because of some legal difficulty. Lorne Hardie bought the property from Alexander on April 3rd, 1884, and sold it to Andrew Kempel on October 13th, 1902. It remained in the Kempel family into the 1950s.

North of Bridge Street, beside the river, is an unnumbered lot, described in the "Index" as "the Lot lying between Lot 116 & the Teeswater". As part of Cromar's village plot, it was sold on December 16th, 1859 to Ninian [spelling?] Woods. No additional transactions are recorded until April of 1905, when the trustees of the Riversdale Presbyterian Church entered a deed to the property in the name of Charles Seymour. It next appears in 1944 when, on December 1st, Andre and Eugenia Freiburger sold it to Cyril Kempel, a member of the family associated with the ownership of the steam mill reserve. There is no evidence, however, in the archival record that this steam mill operated in the study area.

Lots 114-116, fronting Bridge Street and nearest the village lots to the bridge across the Teeswater, share a similar historical sequence as that part of their unnumbered neighbour. All three lots were sold by Cromar to Woods in December of 1859. Because of unpaid taxes, there were sold by "tax deed" by the County of Bruce to Thomas Rookledge in February 1875. They are next recorded in the "Land Index" in April of 1905, being then disposed of to Charles Seymour by the Presbyterian Church trustees. Seymour's widow sold the lots to Pete Valad in April of 1919, and they remained in the possession of the Valad family through the 1930's, eventually being acquired the following decade by the Kempels.

The nature of the bridge indicated on the map of 1856 is unknown. It may have been a structure in 1892, than known as "Cromar's bridge", and being 124 feet (~38 metres) in length (Road and Bridge Committee 1892: 31). Or there may have been successors between 1856 and 1892. The latter was probably replaced in the twentieth century, perhaps as early as 1905, by a 125-foot (~38 metres) "riveted Pratt truss steel bridge" constructed by the Hunter Bridge & Boiler Company (Gateman 1981: 96)."

1.2.3 Rationale for Fieldwork Strategy

The study area exhibits archaeological potential based on the study area abutting the Teeswater River, the early (mid-1850's) village of Riversdale; the use of the river by Indigenous populations for both transportation and resource exploitation. Areas of low potential include those of permanently wet areas, and the poor drainage of the area from mud, bottom land, and other poorly drained soils. Included in the area of low potential is Bridge Street, Sideroad 20 and the bridge structure impacting the environment. The bridge is also a potential indicator of early historic activities (bridge construction) in the area.

The study area was subject to a test pitting methodology conducted in standard five metre intervals.

1.3 Archaeological Context

1.3.1 Previously Known Archaeological Resources/Assessments

There are no registered archaeological sites within one kilometre of the study area (PastPortal 2017), however, this is a reflection of lack of archaeological survey and investigation in this area, rather than as an indicator of verified lack of archaeological sites in the area.

Scarlett Janusas Archaeology Inc. conducted the Stage 1 archaeological assessment (P027-0315-2017) of the study area as part of a larger Stage 1 study. It was determined that the study area had archaeological potential for those areas that were not permanently wet or considered disturbed by roadway and bridgeworks. A property inspection of the area was conducted on July 6th, 2017. Stage 2 archaeological assessment was recommended for the study area.

1.3.2 Current Environment – Existing Features

The study area consists of four areas each measuring 20 by 20 metres on the northwest, northeast, southwest and southeast areas abutting the extant bridge and the Teeswater River. Wetland vegetation occupied the area, and some large trees were also located in the area. The abutments of the bridge were located adjacent to the river and were poured concrete.

1.3.3 Summary of Stage 1 Archaeological Assessment

The Stage 1 archaeological assessment report included both archival research and a property visit. The background research indicated that the area of the Stage 2 assessment (the subject of this report) was bisected by the Teeswater River, the Pratt Truss bridge and Bridge Street. Areas adjacent to the Teeswater River were deemed to be permanently wet areas – the river noted for having little to no banks. Soils were bottomland and muck, with a small area of Toledo silt. All three soils types had poor drainage. Elevation rose from the river, from 270 to 274 metres. There were no prehistoric shorelines in the vicinity, no registered archaeological sites, or archaeological assessments (within 50 metres of the study area). Portions of the current study area were evaluated as having archaeological potential (Map 5).

1.3.4 Dates of Fieldwork

The Stage 2 archaeological assessment was conducted on July 6th, 2017 under sunny skies with a high of 28 degrees Celsius.

As per the Ministry of Tourism, Culture and Sports' Standards and Guidelines (2011: Section 2.1, Standard 3) the fieldwork was conducted under the appropriate lighting and weather conditions.

1.3.5 Unusual Physical Features Affecting Fieldwork

There were areas immediately abutting the Teeswater River that were permanently wet and could not be assessed.

2.0 FIELD METHODOLOGY

2.1 Stage 2 (Archaeological Assessment)

The following table identifies the standard within the Ministry of Tourism, Culture and Sports' Standards and Guidelines document (2011) and how they were met with respect to Stage 2 Field Assessment.

| Standard Section | Standard | Action |
|-------------------------|---|---|
| Property Survey | | |
| 2.1, Standard 1 | Survey the entire property, including lands immediately adjacent to built structures (both intact and ruins), excepting those areas identified by Section 2.1, Standard 2 | Approximately 27% of the study area consisted of slopes in excess of 20 degrees, made up of roadside elevations and slope down to the river. Another 21% (approximately) consisted of permanently wet lands immediately adjacent to the Teeswater River. Approximately 4% of the study area (excluding the bridge span) was considered disturbed. These disturbances consisted of roads and bridge abutments. The remaining 48% of the study area was subject to a test pitting methodology conducted in five metre intervals (Maps 5 and 6). |
| 2.1, Standard 2a | Survey is not required where: a. lands are evaluated as having no or low potential based on the Stage 2 identification of physical features of no or low archaeological potential, including but not limited to: permanently wet areas, exposed bedrock, steep slopes (greater than 20°) except in locations likely to contain pictographs or petroglyphs b. lands are evaluated as having no or low potential based on the Stage 2 identification of extensive and deep land alteration that has severely damaged the integrity of archaeological resources | 52% of the study area was not surveyed as per section 2.1., standard 2a (b), as the area was determined to have been disturbed by existing roadways, and concrete abutments associated with the bridge construction, was permanently wet, or was in area of 20° plus slope.. |

| Standard Section | Standard | Action |
|------------------|---|--|
| | <p>c. lands have been recommended to not require Stage 2 assessment by a Stage 1 report, where the ministry has accepted the Stage 1 report into the Ontario Public Register of Archaeological Reports</p> <p>d) lands are designated for forest management activity without potential for impacts to archaeological sites, as determined through the Stage 1 forest management plans process (see section 1.4.3)</p> <p>e) lands are formally prohibited from alteration such as areas in an environmental easement, restrictive setback, or prohibitive zoning, where the constraint prohibits any form of soil disturbance. (Open space and other designations where allowable uses include land alterations must be surveyed.)</p> <p>f) it has been confirmed that the lands are being transferred to a public land-holding body, e.g., municipality, conservation authority, provincial agency. (This does not apply to lands for which a future transfer is contemplated but not yet confirmed.)</p> | |
| 2.1, Standard 3 | Survey the property when weather and lighting conditions permit good visibility of land features | July 6 th , 2017. Sunny, high of 28°C. |
| 2.1, Standard 4 | Using the Global Positioning System (GPS) according to the requirements set out in section 5, record the locations of the following: all diagnostic artifacts, sufficient artifacts to provide an estimate of the limits of the archaeological site, and all fixed reference landmarks | NW 17T473917.09E, 4882320.01N NE 17T473072.01E, 4882337.36N SE 17T4730872.00E 4882294.32N SW 17T473033.35E, 4882273.03N |
| 2.1, Standard 5 | Map all field activities (e.g., extent and location of survey methods, survey intervals) in reference to fixed landmarks, survey stakes and | Done – test pitting map and image map |

| Standard Section | Standard | Action |
|------------------------------|--|---|
| | development markers. Mapping must be accurate to 5 m or to the best scale available. Use any mapping system that achieves this accuracy. | |
| 2.1, Standard 6 | Photo-document examples of all field conditions encountered | Done – see images |
| 2.1, Standard 7 | Do not use heavy machinery (e.g., gas-powered augers, backhoes) to remove soil, except when removing sterile or recent fill covering areas where it has been determined that there is the potential for deeply buried or sealed archaeological sites | Done – no use of heavy machinery |
| Pedestrian Survey | | Not applicable – all test pitted |
| Test Pit Survey | | |
| 2.1.2, Standard 1 | Test pit survey only on terrain where ploughing is not possible or viable, as in the following examples: wooded areas, pasture with high rock content abandoned farmland with heavy brush and weed growth, orchards and vineyards that cannot be strip ploughed (planted in rows 5 m apart or less), gardens, parkland or lawns, any of which will remain in use for several years after the survey properties where existing landscaping or infrastructure would be damaged. The presence of such obstacles must be documented in sufficient detail to demonstrate that ploughing or cultivation is not viable. | The areas subject to test pitting consisted of riverside wooded areas and tall grasses. |
| 2.1.2, Standard 2 | Test pits were spaced at maximum intervals of 5 m (400 test pits per hectare) in areas less than 300 m from any feature of archaeological potential. | Done |
| 2.1.2, Standard 3 | Space test pits at maximum intervals of 10 m (100 test pits per hectare) in areas more than 300 m from any feature of archaeological potential | Not applicable |

| Standard Section | Standard | Action |
|--------------------------|---|---|
| 2.1.2, Standard 4 | Test pit to within 1 m of built structures (both intact and ruins), or until test pits show evidence of recent ground disturbance | Done – to one metre of bridge abutments |
| 2.1.2, Standard 5 | Ensure that test pits are at least 30 cm in diameter. | Done |
| 2.1.2, Standard 6 | Excavate each test pit, by hand, into the first 5 cm of subsoil and examine the pit for stratigraphy, cultural features, or evidence of fill. | Test pits averaged 30 cm in depth. Soils consisted of silty clay over a grey clay subsoil. Soil depth ranged from 30 cms to 35 cms. All soils were very wet below 10 cms of excavation depth. |
| 2.1.2 Standard 7 | Screen soil through mesh no greater than 6 mm. | Done |
| 2.1.2 Standard 8 | Collect all artifacts according to their associated test pit | Not applicable |
| 2.1.2 Standard 9 | Backfill all test pits unless instructed not to by the landowner. | Done |

Map 4 illustrates the location of the study area. No formal plan for the proposed development of the study area exists at this time, as results of this assessment and other studies will assist in development strategy. Map 7 illustrates the images taken of the archaeological assessment (Images 1 - 13), Map 5 illustrates the archaeological potential of the study area, and, Map 6 illustrates assessment methodology.

Approximately 27% of the study area consisted of slopes in excess of 20 degrees, made up of roadside elevations and slope down to the river. Another 21% (approximately) consisted of permanently wet lands immediately adjacent to the Teeswater River. Approximately 4% of the study area (excluding the bridge span) was considered disturbed. These disturbances consisted of roads and bridge abutments. The remaining 48% of the study area was subject to a test pitting methodology conducted in five metre intervals (Map 6).

No archaeological materials or features were located in the study area.

As per Section 2.2 of the Standards and Guidelines (MTC 2011), there is no requirement for Stage 3 archaeological assessment, as there were no archaeological sites located during the Stage 2 assessment.

3.0 RESULTS

3.1 Stage 2 Archaeological Assessment

Stage 2 archaeological assessment was conducted in those areas with archaeological potential, excluding those areas of steep slope, development disturbance and permanently wet areas. Stage 2 methodology was a test pitting strategy conducted in five metre intervals.

3.2 Summary of Finds

No archaeological material, features or sites were located during the Stage 2 archaeological assessment.

3.3 Inventory of Documentary Records Made In Field

Documents made in the field include:

- Daily record log and field notes – 2 pages
- Image log – 1 page
- Digital images – 13 colour images
- Field map showing location and orientation of image(s) taken.

4.0 ANALYSIS AND CONCLUSIONS

Approximately 27% of the study area consisted of slopes in excess of 20 degrees, made up of roadside elevations and slope down to the river. Another 21% (approximately) consisted of permanently wet lands immediately adjacent to the Teeswater River. Approximately 4% of the study area (excluding the bridge span) was considered disturbed. These disturbances consisted of roads and bridge abutments. The remaining 48% of the study area was subject to a test pitting methodology conducted in five metre intervals (Map 5 and 6).

No archaeological material, features or sites were located during the Stage 2 archaeological assessment.

Based on Section 2.2 of the Standards and Guidelines, no further archaeological assessment is required for the study area.

5.0 RECOMMENDATIONS

Based on the results of the Stage 1, and Stage 2 archaeological assessments of past and present conditions, the following is recommended:

- No further archaeological assessment is required for the study area.
- Compliance legislation must be adhered to in the event of discovery of deeply buried cultural material or features.

6.0 ADVICE ON COMPLIANCE WITH LEGISLATION

According to the 2011 Standards and Guidelines (Section 7.5.9) the following must be stated within this report:

This report is submitted to the Minister of Tourism, Culture and Sport as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18. The report is reviewed to ensure that it complies with the standards and guidelines that are issued by the Minister, and that the archaeological fieldwork and report recommendations ensure the conservation, protection and preservation of the cultural heritage of Ontario. When all matters relating to archaeological sites within the project area of a development proposal have been addressed to the satisfaction of the Ministry of Tourism, Culture and Sport, a letter will be issued by the ministry stating that there are no further concerns with regard to alterations to archaeological sites by the proposed development.

It is an offence under Sections 48 and 69 of the Ontario Heritage Act for any party other than a licensed archaeologist to make any alteration to a known archaeological site or to remove any artifact or other physical evidence of past human use or activity from the site, until such time as a licensed archaeologist has completed archaeological fieldwork on the site, submitted a report to the Minister stating that the site has no further cultural heritage value or interest, and the report has been filed in the Ontario Public Register of Archaeological Reports referred to in Section 65.1 of the Ontario Heritage Act.

Should previously undocumented archaeological resources be discovered, they may be an archaeological site and therefore subject to Section 48 (1) of the Ontario Heritage Act. The proponent or person discovering the archaeological resources must cease alteration of the site immediately and engage a licensed consultant archaeologist to carry out archaeological fieldwork, in compliance with sec. 48 (1) of the Ontario Heritage Act.

The Cemeteries Act, R.S.O. 1990 c. C.4 and the Funeral, Burial and Cremation Services Act, 2002, S.O. 2002, c.33 require that any person discovering human remains must notify the police or coroner and the Registrar of Cemeteries at the Ministry of Consumer Services.

Archaeological sites recommended for further archaeological fieldwork or protection remain subject to Section 48 (1) of the Ontario Heritage Act and may not be altered, or have artifacts removed from them, except by a person holding an archaeological license.

7.0 BIBLIOGRAPHY AND SOURCES

Government of Ontario

1990a **The Ontario Heritage Act R.S.O. 1990.** Ontario Regulation 9/06, made under the Ontario Heritage Act. Criteria for Determining Cultural Heritage Value or Interest. Queen's Printer, Toronto.

1990b **The Planning Act. R.S.O. 1990.**

Ministry of Tourism and Culture

2011 **Standards and Guidelines for Consulting Archaeologists.** Ministry of Tourism, Culture and Sport.

Ministry of Tourism, Culture and Sport

2015 Archaeological Data Base Files. Ministry of Tourism, Culture and Sport, Toronto. Provided through Pastport.

Past Portal

2017 Registered Site Data, Ministry of Tourism, Culture and Sport.

Scarlett Janusas Archaeology Inc.

2017 Stage 1 Archaeological Assessment, Proposed Bridge Replacement or Upgrade, Part Lots 30 and 31, Concession 1 NDR, Geographic Township of Greenock, Municipality of Brockton, Bruce County (former Saugeen County), Original Report. P027-0315-2017

On Line and Other Sources

Bruce County Interactive Mapping

www.Brucecounty.on.ca/map

Topographic Mapping

www.atlas.nrcan.gc.ca

The Atlas of Canada, Map of the Area of the 9 August 1836 Treaty

<http://atlas.gc.ca/sites/english/maps/historical/indiantreaties/historicaltreaties>

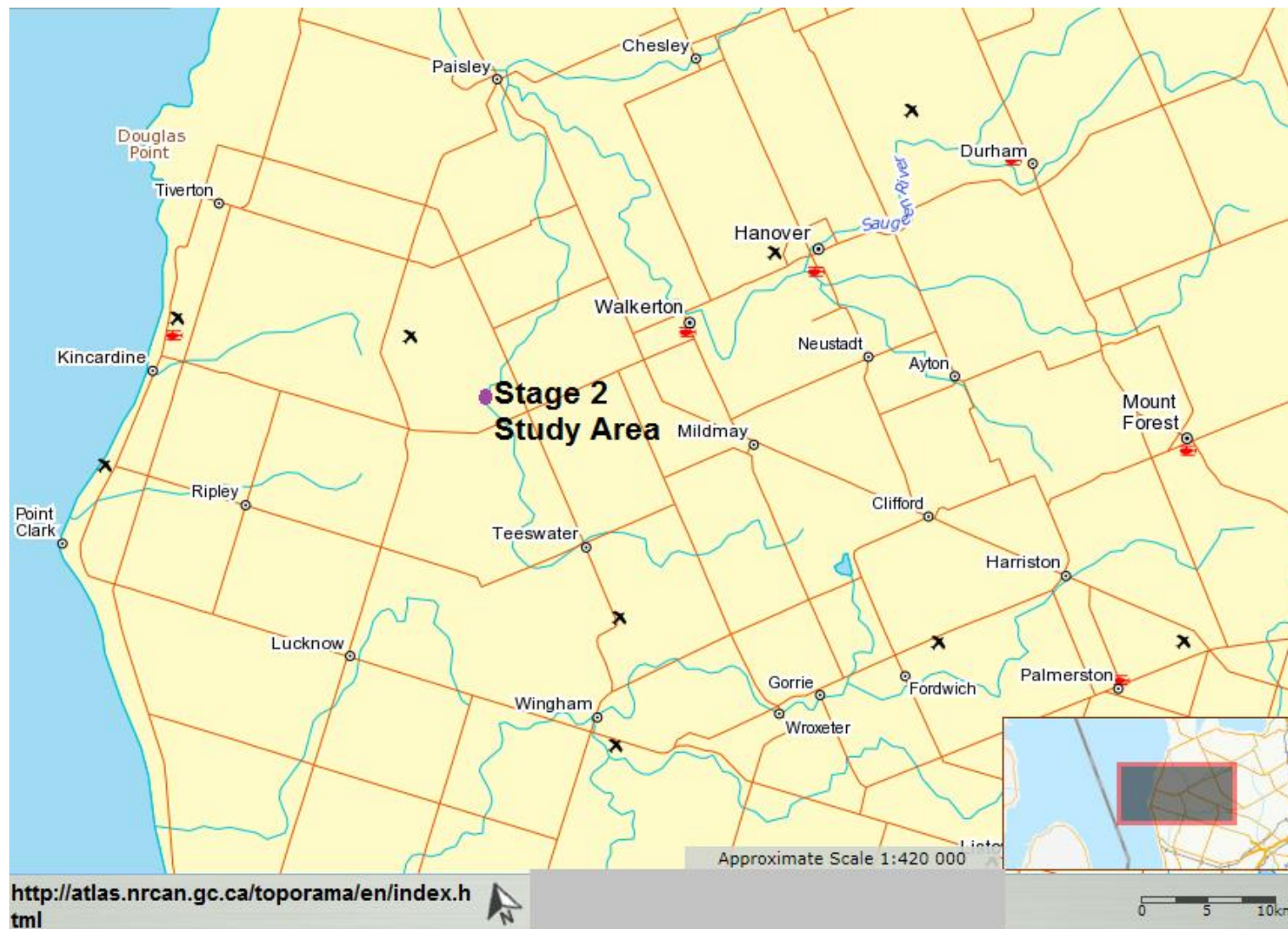
MAPS

Map 1: Provincial Location of Study Area

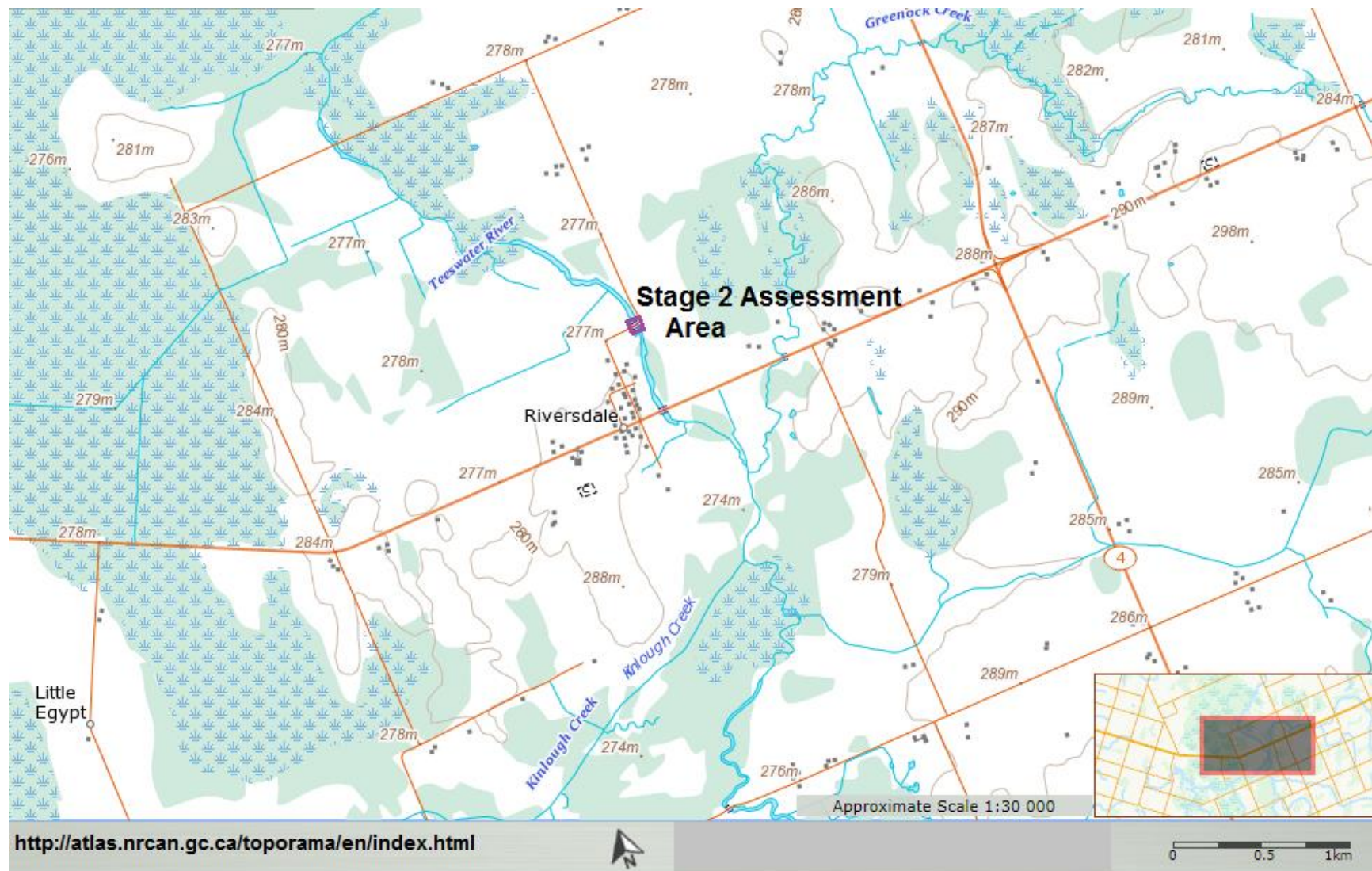


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Sa Majesté la Reine du chef du Canada, Ressources naturelles Canada.

Map 2: Regional Map of Study Area



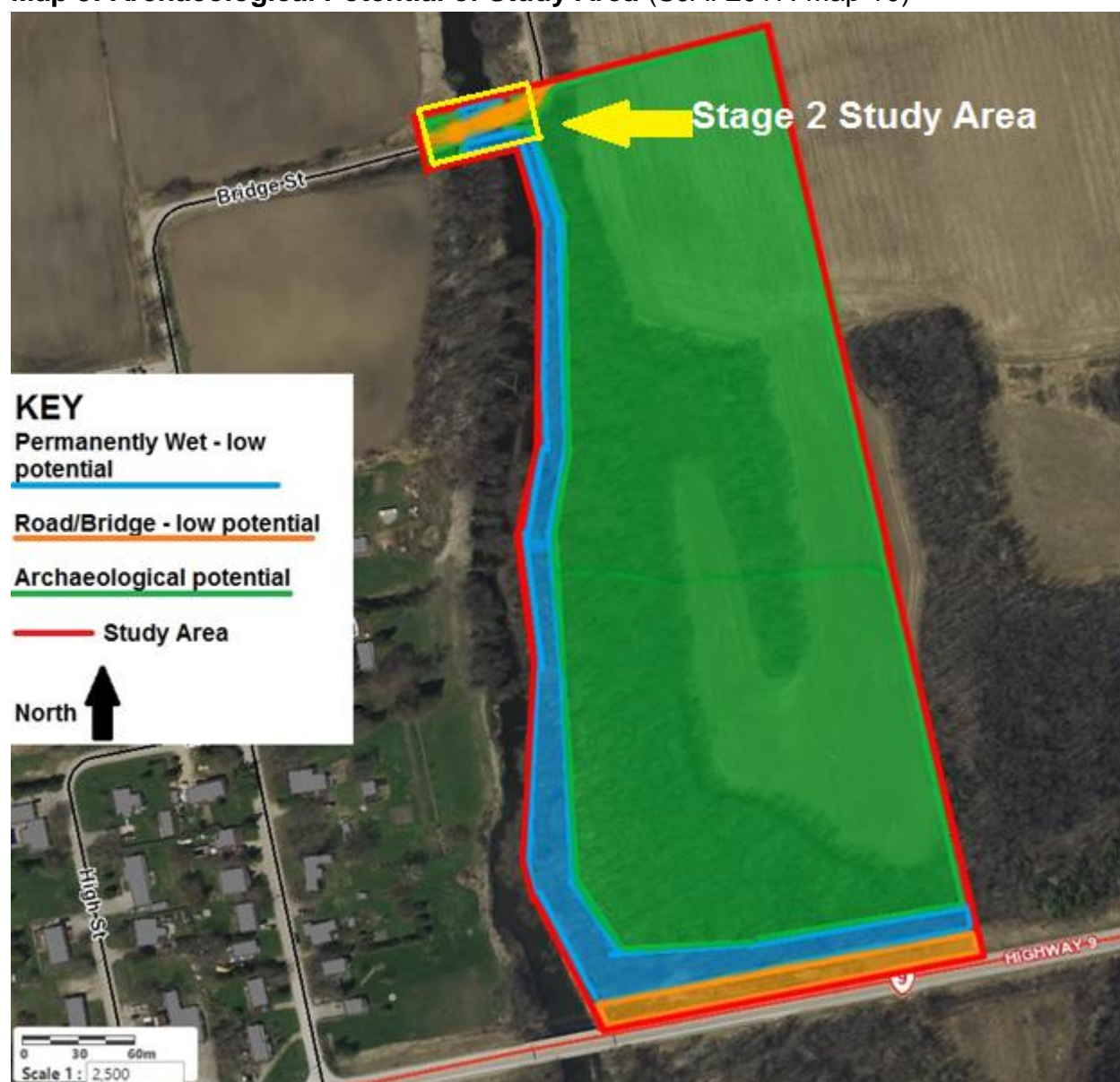
Map 3: Topographic Map of Study Area



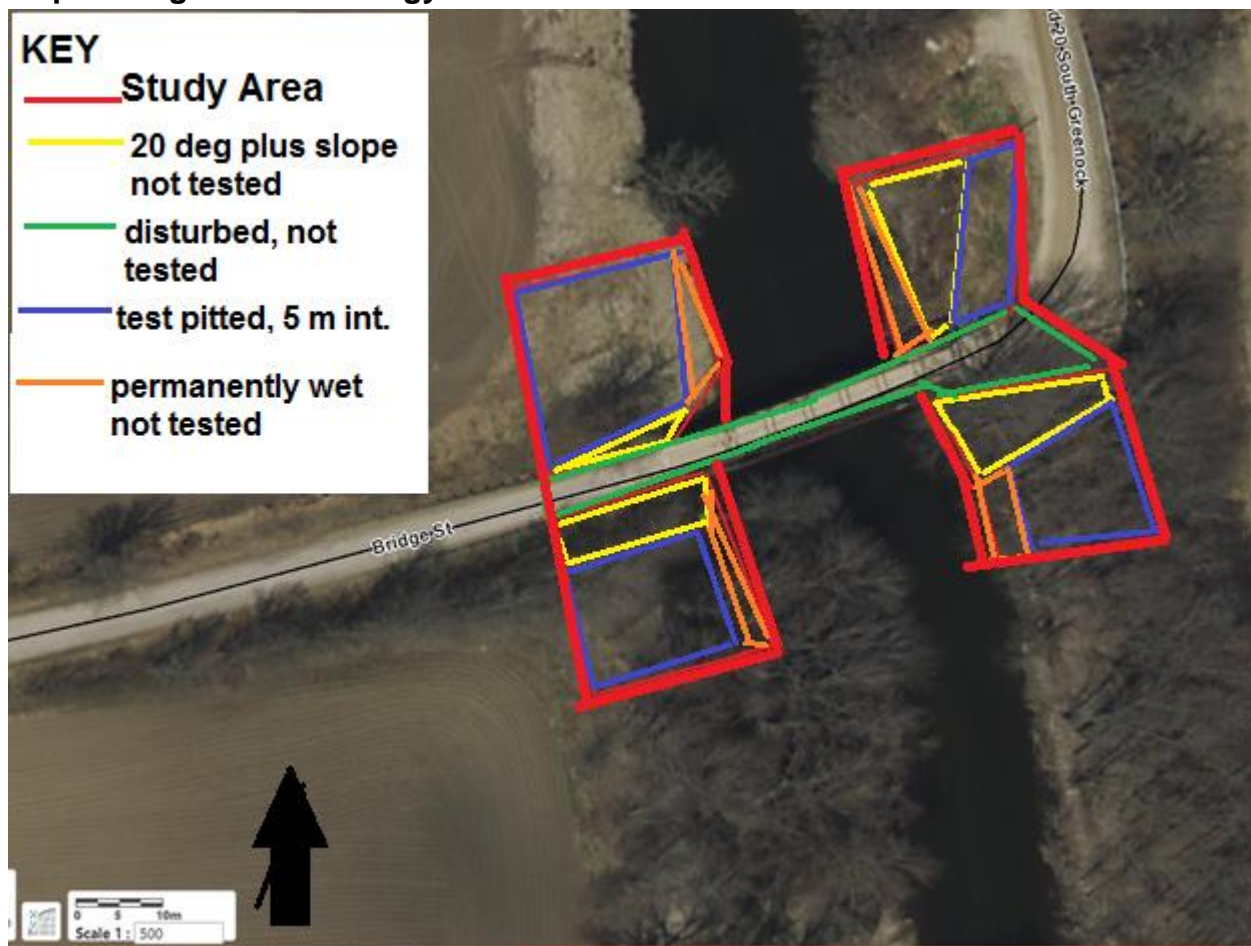
Map 4: Stage 2 Assessment Area

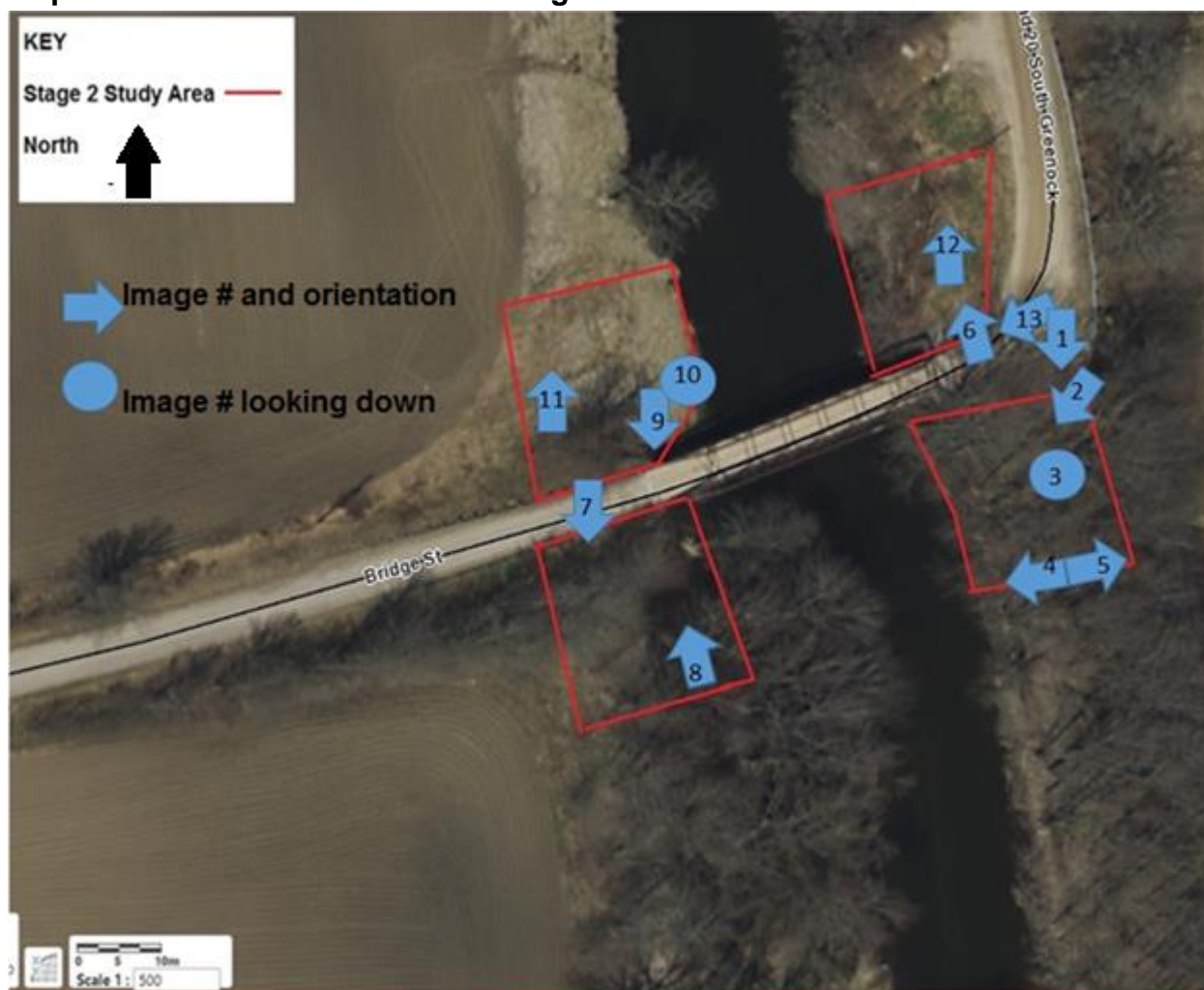


Map 5: Archaeological Potential of Study Area (SJA 2017: Map 10)



Map 6: Stage 2 Methodology



Map 7: Location and Direction of Images

IMAGES

Image 1: 20° Plus Slope from Road facing SE



Image 2: Shovel testing in SE corner of study area (facing S)



Image 3: Test Pit in SE corner of study area facing down



Image 4: Southeast Corner facing SW, drain from adjacent field



Image 5: Southeast Corner facing NE, drain from adjacent field



Image 6: Northeast Corner of Study Area, 20° slope, facing NW



Image 7: Test Pitting Southwest Corner of Study Area facing SE



Image 8: Testing Southwest Corner, facing NW (note extreme slope at roadside in background)



Image 9: Facing SE at Bridge Abutment, Northwest Corner



Image 10: Facing down, permanently wet area, Northeast Corner



Image 11: Test Pitting Northwest Corner facing Northwest



Image 12: Test Pitting in Northeast Corner facing NW



Image 13: Riversdale Bridge facing SW



Appendixes

Appendix A: Image Log

| Image # | Comments | Direction | Date |
|---------|--|-----------|--------------|
| 1 | 20° Plus Slope from Road | SE | July 6, 2017 |
| 2 | Shovel testing in SE corner of study area | S | July 6, 2017 |
| 3 | Test Pit in SE corner of study area | down | July 6, 2017 |
| 4 | Southeast Corner, drain from adjacent field | SW | July 6, 2017 |
| 5 | Southeast Corner, drain from adjacent field | NE | July 6, 2017 |
| 6 | Northeast Corner of Study Area, 20° slope | NW | July 6, 2017 |
| 7 | Test Pitting Southwest Corner of Study Area | SE | July 6, 2017 |
| 8 | Testing Southwest Corner, extreme slope at roadside in background) | NW | July 6, 2017 |
| 9 | Bridge Abutment, Northwest Corner | SE | July 6, 2017 |
| 10 | Permanently wet area, Northeast Corner | down | July 6, 2017 |
| 11 | Test Pitting Northwest Corner | NW | July 6, 2017 |
| 12 | Test Pitting in Northeast Corner | NW | July 6, 2017 |
| 13 | Riversdale Bridge | SW | July 6, 2017 |

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Jul 19, 2017

Scarlett Janusas (P027)
Scarlett Janusas Archaeology Inc.
PO BOX none Tobermory ON N0H 2R0

RE: Entry into the Ontario Public Register of Archaeological Reports: Archaeological Assessment Report Entitled, "STAGE 1 ARCHAEOLOGICAL ASSESSMENT PROPOSED BRIDGE REPLACEMENT OR UPGRADE PART LOTS 30 AND 31, CONCESSION 1 NDR GEOGRAPHIC TOWNSHIP OF GREENOCK MUNICIPALITY OF BROCKTON BRUCE COUNTY (FORMER SAUGEEN COUNTY) ORIGINAL REPORT ", Dated Jul 11, 2017, Filed with MTCS Toronto Office on N/A, MTCS Project Information Form Number P027-0315-2017, MTCS File Number 0007028

Dear Ms. Janusas:

The above-mentioned report, which has been submitted to this ministry as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18, has been entered into the Ontario Public Register of Archaeological Reports without technical review.¹

Please note that the ministry makes no representation or warranty as to the completeness, accuracy or quality of reports in the register.

Should you require further information, please do not hesitate to send your inquiry to Archaeology@Ontario.ca

cc. Archaeology Licensing Officer
John Strader, Municipality of Brockton
Chris LaForest, County of Bruce, Planning and Economic Department

¹In no way will the ministry be liable for any harm, damages, costs, expenses, losses, claims or actions that may result: (a) if the Report(s) or its recommendations are discovered to be inaccurate, incomplete, misleading or fraudulent; or (b) from the issuance of this letter. Further measures may need to be taken in the event that additional artifacts or archaeological sites are identified or the Report(s) is otherwise found to be inaccurate, incomplete, misleading or fraudulent.

Ministry of Tourism, Culture and Sport

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Sep 8, 2017

Scarlett Janusas (P027)
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RE: Review and Entry into the Ontario Public Register of Archaeological Reports: Archaeological Assessment Report Entitled, "STAGE 2 ARCHAEOLOGICAL ASSESSMENT PROPOSED BRIDGE REPLACEMENT OR UPGRADE PART LOTS 30 AND 31, CONCESSION 1 NDR GEOGRAPHIC TOWNSHIP OF GREENOCK MUNICIPALITY OF BROCKTON BRUCE COUNTY (FORMER SAUGEEN COUNTY) ORIGINAL REPORT ", Dated Jul 11, 2017, Filed with MTCS Toronto Office on Jul 19, 2017, MTCS Project Information Form Number P027-0317-2017, MTCS File Number 0007028

Dear Ms. Janusas:

This office has reviewed the above-mentioned report, which has been submitted to this ministry as a condition of licensing in accordance with Part VI of the Ontario Heritage Act, R.S.O. 1990, c 0.18.¹ This review has been carried out in order to determine whether the licensed professional consultant archaeologist has met the terms and conditions of their licence, that the licensee assessed the property and documented archaeological resources using a process that accords with the 2011 Standards and Guidelines for Consultant Archaeologists set by the ministry, and that the archaeological fieldwork and report recommendations are consistent with the conservation, protection and preservation of the cultural heritage of Ontario.

The report documents the assessment of the study area as depicted in Map 6: Stage 2 Methodology and Map 4: Stage 2 Assessment Area of the above titled report and recommends the following:

Based upon the background research of past and present conditions, and the archaeological assessment, the following is recommended:

- No further archaeological assessment is required for the study area.
- Compliance legislation must be adhered to in the event of discovery of deeply buried cultural material or features.

Based on the information contained in the report, the ministry is satisfied that the fieldwork and reporting for the archaeological assessment are consistent with the ministry's 2011 Standards and Guidelines for Consultant Archaeologists and the terms and conditions for archaeological licences. This report has been entered into the Ontario Public Register of Archaeological Reports. Please note that the ministry makes no

representation or warranty as to the completeness, accuracy or quality of reports in the register.

Should you require any further information regarding this matter, please feel free to contact me.

Sincerely,

Sarah Roe
Archaeology Review Officer

cc. Archaeology Licensing Officer
John Strader, Municipality of Brockton
Chris LaForest, County of Bruce, Planning and Economic Department

¹In no way will the ministry be liable for any harm, damages, costs, expenses, losses, claims or actions that may result: (a) if the Report(s) or its recommendations are discovered to be inaccurate, incomplete, misleading or fraudulent; or (b) from the issuance of this letter. Further measures may need to be taken in the event that additional artifacts or archaeological sites are identified or the Report(s) is otherwise found to be inaccurate, incomplete, misleading or fraudulent.

BRIDGE STREET (BRIDGE 0002) RIVERSDALE CULTURAL HERITAGE EVALUATION REPORT AND PRELIMINARY CULTURAL HERITAGE IMPACT ASSESSMENT



Prepared for:
Municipality of Brockton

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© July 21, 2017 Revised August 25, 2018

PROJECT PERSONNEL

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BRIDGE STREET (BRIDGE 0002) RIVERSDALE CULTURAL HERITAGE EVALUATION REPORT AND PRELIMINARY CULTURAL HERITAGE IMPACT ASSESSMENT

1.0 INTRODUCTION

1.1 Project Description

This report is a preliminary cultural heritage impact assessment intended to inform stakeholders in the Environmental Assessment (EA) process. The report is presented as “preliminary” to inform all of the alternatives considered as part of the EA process. A final Heritage Evaluation Report will consider the impacts and mitigation options for just one of the

GM BluePlan Engineering retained the services of Scarlett Janusas Archaeology Inc. (SJA) to conduct a cultural heritage evaluation report (CHER) and Preliminary Cultural Heritage Impact Assessment (CHIA) on behalf of the Municipality of Brockton for the Riversdale Bridge, also referred to as Bridge 0002, located on Bridge Street, between lots 30 and 31, Concession 1 NDR (north of the Durham Road), former geographic township of Greenock, now the Municipality of Brockton, Bruce County (Figures 1 and 2).

The bridge is a 125-foot (~38 metres) “riveted Pratt truss steel bridge” constructed by the Hunter Bridge & Boiler Company for the sum of \$1,925.00 ca. 1905 with a single span, and a 16’ 4.38” (5 metre) total bridge width and a 14’ (4.30 m) deck. The bridge crosses the Teeswater River northeast of the village of Riversdale. This is a municipally owned bridge (#0002) located on a concession road. It is also referred to by MTO as bridge #2-262. A Municipal Heritage Bridges Cultural, Heritage and Archaeological Resources Assessment Checklist (revised April 11th, 2014) was completed on March 3rd, 2018.

The cultural heritage evaluation was conducted to determine the appropriate Project Schedule of the Environmental Assessment process that will be required to address the existing structural deficiencies for the aging bridge located in Riversdale.

A bridge inspection was conducted on July 3rd 2014 (Appendix A/Palmay 2015). Specific details are presented in the appendix, and the summary indicates the following:

“The structure appears to be in overall fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed (noted since the 2007 report), and appears to be in overall fair condition and structurally adequate. The concrete substructure appears to be in overall poor condition with severe to very severe

cracking, spalling and delamination. The overall stability of the concrete abutments and wingwalls is questionable. The severe vertical crack through the northwest wingwall was identified in the 2005 report. Although the crack does not appear to be getting larger, failure of this wingwall will cause the single lane approach to slump which will require closure of the road to repair.

Recommendations:

1. Clean truss seats (within 2 years).
2. Replace missing posts, bearing blocks, and repair damaged areas of approach guiderails (within 2 years).
3. Replace missing warning sign in south east corner (within 5 years).
4. Replace structure within 5 years” (Palmay 2015).

This report includes a historical summary of the bridge environs, a description and history of the bridge, an evaluation of the cultural heritage value of the bridge, a summary of cultural heritage value and recommendations stemming from the same. The bridge has been evaluated using prescribed criteria from Ontario Regulation 9/06, developed for the purpose of identifying cultural heritage value or interest for properties proposed for protection under the Ontario Heritage Act (Section 29). There are three criteria used in the evaluation: design or physical value; historical or associative value; and, contextual value.

Appendix B presents the MCEA, Municipal Heritage Bridges Cultural, Heritage and Archaeological Resources Assessment Checklist for the Riversdale Bridge. Appendix C is the Bridge Survey Form. Appendices D to J present supporting documentation. Historic maps are presented within Section 2.0 (Historic Background), and Images of the bridge are presented in the Images section.

“Community engagement and public consultation will be completed as part of the EA process” (Nelson 2018: personal communication).

Figure 1: Regional Location of Study Area (Toporama 2017)

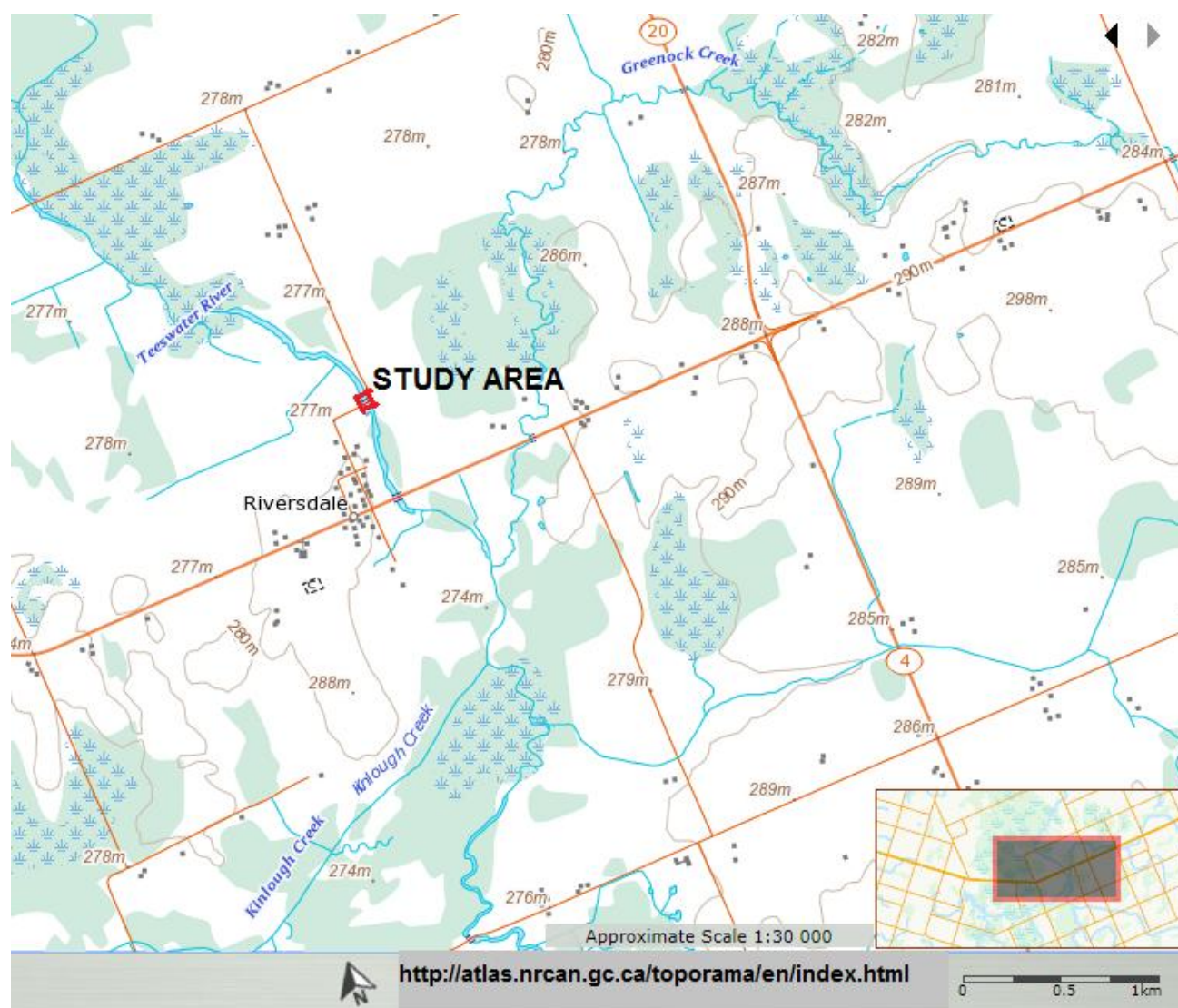


Figure 2: Location of Study Area (Bruce County Mapping 2017)



2.0 HISTORIC BACKGROUND

2.1 General and Township History

The following is from Fitzgerald (2012: 4-6), who conducted the Stage 1 archaeological assessment for six bridges, including the Study Bridge under PIF P097-058-2012:

“The study area [encompasses more than the current study area] is located within the Sauking (Saugeen Ojibway) Indian hunting territory south of the Bruce Peninsula that was surrendered to the “Great Father” (William IV) under the terms of Treaty No. 45 ½ on August 9, 1836.

Treaty No. 45 ½’s configuration is a byproduct of earlier historical events. What would eventually be defined as the southeast corner of Saugeen Ojibway hunting territory – the current intersection of Highway 6 and Wellington Road 109/Highway 9, has been established within Treaty No. 3 between the Mississauga and the Crown on December 7, 1792 as the endpoint of a 50-mile survey transect originating at the outlet of Burlington Bay into Lake Ontario. This reference point was subsequently used in all major southern Ontario treaties of the late-18th and early-19th centuries.

On October 17, 1818, Treat No. 18 conveyed a 1.592 million-acre tract of Chippewa lands within the northern section of the Home District to the Crown. The treaty area’s western limit was defined by a line projecting northward (15°W) from the 1792 50-mile endpoint – now beginning as County Road 14, to Vail’s Point on Georgian Bay. This line, by default, would later serve as Treaty No. 45 ½’s eastern limit.

On April 26, 1825, Treaty No. 27 ½ surrendered and conveyed another substantial section of Chippewa territory to the Crown (George IV). This time the future intersection of Highway 6 and Highway 9/Wellington Road 109 served as the treaty area’s northeast corner of reference - - the northern limit of the surrender stretched westward (5°W) from the 1792 50-mile endpoint to a point on Lake Huron 10 ¾ miles north of the mouth of the William FitzWilliam Owen’s Red River. By 1825 [sic] it was known as the Menesetunk River – today it is the Maitland River. This line would in 1836 serve, also by default, as the southern boundary of Saugeen Ojibway territory.

With the colonial government’s desire to expedite the opening of the newly-acquired Treaty 45 ½ lands – the “Queen’s Bush”, for Euro-Canadian settlement and commerce, routes were initially scouted for roads that would link Oakville and Toronto to the head of Owen’s Sound (Sydenham) on Georgian Bay.

The first was a route surveyed in 1837 by Charles Rankin that would serve as the northern extension of the Oakville-Owen’s Sound Road between the northwest corner of Wellington County’s Garafraxa Township – the aforementioned 1792 “50-mile endpoint”, and the east side of the head of Owen’s Sound. In 1840 and 1841 [sic] John McDonald formalized Rankin’s route and established 50-acre free land grants on either side of it to entice settlers and as a means to open the road. The route became more popularly known as the Garafraxa Road – today it is the stretch of Highway 6 between Arthur and

Owen Sound.

Another colonization road was ordered in 1848 to link Hurontario Street in Nottawasaga Township (Simcoe County) and the mouth of the Penetangore River on Lake Huron. This east-west road crossed the north-south Garafraxa Road at the reserve for the future town of Durham – hence the road's name. Allan Park Brough surveyed the western section of the Durham Road – between Garafraxa Road and the mouth of the Penetangore, between 1848 and 1850. As with the Garafraxa Road, 50-acre free land grants were offered along sections of the Durham Road that passed through the future townships of Bentinck, Brant, Greenock, Kinloss, and Kincardine. Two town reserves were set aside by Brough along the western section of the Durham Road: Penetangore at the road's western terminus (present-day Kincardine); the other straddling the Brant-Greenock town line (never established). Today the western section of the Durham Road is better known as Grey/Bruce Road 4 between Durham and Walkerton and Highway 9 between Walkerton and Kincardine.

With the completion of the survey of the Durham Road, the lands on either side of the road and its free grants – and further into the interior, began in 1850 to be divided into townships and farm lots...

....

As part of his April 7 to August 26, 1851 survey of Saugeen Township, Alexander Vital established a range of lots on either side of the proposed route of the Saugeen [sic] and Elora Road in Elderslie and Greenock townships. Robert Walsh surveyed the remaining areas of Greenock Township between May 26 and October 6, 1851. Between May 15 and November 3, 1851, George McPhillips surveyed the remainder of Elderslie Township.

The surveyors who laid out Brant, Greenock, and Elderslie townships must have reported to the Commissioners of Crown Lands the challenges of constructing the Saugeen [sic] and Elora Road along the town lines of the townships in the vicinity of the confluence of the Teeswater and Saugeen Rivers. On July 14, 1851 – likely due to the meandering of the Teeswater and large number of crossings that would have to be constructed, George McPhillips was instructed to:

...mark out a line for a road from the rear of Brant to the Saugeen River in Elderslie...selecting the best site for bridges over the Mud River and River Saugeen, and making the necessary sinuosities to avoid hills and swamps.

McPhillip's Saugeen and Elora Road deviation through Elderslie Township – now part of Bruce Road 3, avoided river crossings until it reached the confluence of the Teeswater and Saugeen rivers at the town reserve of Paisley. Not only did the route of the Saugeen and Elora Road deviate eastward from the Greenock-Brant town line, within Brant Township its route was shifted eastward from the Greenock-Brant town line to the road right-of-way along the east side of Brant Concession B.

...

Today, Brough and Vidal's originally-proposed route of the Saugheen and Elorra Road is a series of town lines of varying quality whose northern end is Greenock Township's Concession 20 Road – the road having never been pushed through to the town reserve of Paisley. Watson's and Dudgeon bridges are located along this original route; the Concession 20 Bridge lies to its immediate west in Greenock Township."

Greenock Township was the last township south of the peninsula to be surveyed in the original county of Bruce (Norman Robertson 1904; 401-407). Excerpts from the Report of the County Valuers of 1879 said:

"Greenock Township has more inferior land than any other south of the peninsula. The Mud River having hardly any banks around it for a long distance is flooded in the spring to the depth of three or four feet. It has a far larger amount of swamp than any other in the county, and when the pine is taken off it will not be of any value. There is a portion of good land around Chepstowe, and the most of the gore is first-class land. It has a large amount of mill property. Its average price is \$22.60 per acre."

And, from 1901:

"Greenock is a gore township and very few roads are open through from east to west, none being open between the Durham Road and the 10th concession, on account of what is known as the Greenock swamp. A portion of this swamp has been reclaimed since the last valuation, but still there is a great deal to do in the same line. The 6th concession was being opened through the swamp when your valuers were there, which will be a great convenience, especially to the settlers in the western part of the township, and also to those of the eastern part of Kincardine township. There are portions of Greenock as good as can be found in the county, but a very considerable portion is swamp, and a great deal of the northern part is stiff clay, in fact, so stiff that it affects its value considerably. The rate per acre, including village property, is \$25.66, of which amount the village property is \$2.39 per acre."

Mr. R. Walsh surveyed the Township of Greenock in 1852, however it was not until September 27th, 1854 that the Crown sold the lands, excepting the free grants, during the "big land sale". The Crown sold the lands at 7s. 6d. per acre. The first settlers to take up land in the township were Joseph Chartrand and John Caskanete, French Canadians, who had been on the staff of A. P. Brough, P.L.S., when he surveyed the Durham road. Greenock settlement was slow to start, and there were no roads going east and west through the county due to the large swampland at its centre. Many bridges and roads were constructed in later years to aid in travel across the county, and at one point talk of dredging "Mud River" or Teeswater River was undergone to improve the flood plains drainage (Norman Robertson 1904; 401-407).

2.1.1 Riversdale Village

The first settlers of Greenock subsequently developed a town at the point where the Teeswater River is crossed by Durham road and took up lots on which the village of Riversdale now stands. In the spring of 1850, John Caskanette and Joseph Chartrand brought their families. Riversdale was surveyed into village lots in 1855, at the instance of Joseph C. Chartrand, George Cromar and James Bennie; but it may date its commencement from the time a post-office was established there in 1854. George Cromar was the foremost man in the little village at that time, and continued as such until his death, which occurred in the summer of 1861. In 1857 he built a steam saw and grist mill; then the usual supply of blacksmith shops and hotels appeared one after another. A Division Court also had its office there. In 1860 James Millar and Anthony Mason rented the mills from Mr. Cromar, and after his death purchased them from the •executors of the estate. These mills have had an unfortunate experience from fire, having been burned down some five or six times. The Presbyterian congregation at Riversdale was formed about 1857, the Rev. Walter Inglis being the first minister. The present church building of this congregation was dedicated in October 1880. There is also at Riversdale a Roman Catholic Church, but for many years there has been no resident priest there (Robertson 1904: 402).

2.1.2 Specific Lot History, Lots 30 and 31, Concession 1 NDR

The Crown patent to Lot 30 (50 acres) (~20 hectares) was issued to George Cromar on August 26th, 1856. Even before the patent was issued, Cromar was in occupation and with the intention of development a village, he had the site of what became Riversdale surveyed (Kertland 1856). The Plan (Figure 3), which is dated January 20th, 1856, shows a bridge across the Teeswater River at the foot of Bridge Street. On the south side of Bridge Street and adjacent to the river, there was a designated a “Reserve for Steam Mills” of 3.5 acres (~1.4 hectares). Based on the entries in the Abstract Land Index, there appears to have been no actual mill development on the property, perhaps because Cromar died in 1861. His executors sold the acreage on October 15th, 1862 to James Millar. It passed to John Alexander in January of 1866, then to James Johnston in April of 1877, but was still in Alexander’s name apparently because of some legal difficulty. Lorne Hardie bought the property from Alexander on April 3rd, 1884, and sold it to Andrew Kempel on October 13th, 1902. It remained in the Kempel family into the 1950s.

North of Bridge Street, beside the river, is an unnumbered lot, described in the “Index” as “the Lot lying between Lot 116 & the Teeswater”. As part of Cromar’s village plot, it was sold on December 16th, 1859 to Ninian [spelling?] Woods. No additional transactions are recorded until April of 1905, when the trustees of the Riversdale Presbyterian Church entered a deed to the property in the name of Charles Seymour. It next appears in 1944 when, on December 1st, Andre and Eugenia Freiburger sold it to Cyril Kempel, a member of the family associated with the ownership of the steam mill reserve. There is no evidence, however, in the archival record that this steam mill operated in the study area. Figure 4 illustrates the 1880 map section of Riversdale.

Figure 3: Part of 1856 Townplot of Riversdale

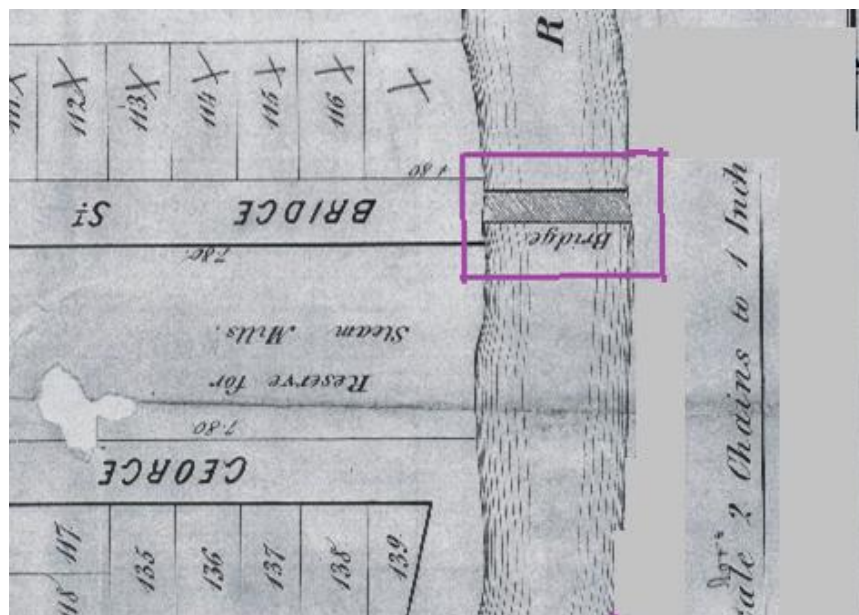


Figure 4: 1880 Illustrated Historic Atlas Map Section (Belden & Co.)



Lots 114-116, fronting Bridge Street and closest to the village lots to the bridge across the Teeswater, share a similar historical sequence as that part of their unnumbered neighbour. All three lots were sold by Cromar to Woods in December of 1859. Because of unpaid taxes, they were sold by "tax deed" by the County of Bruce to Thomas Rookledge in February 1875. They are next recorded in the "Land Index" in April of 1905, being then disposed of to Charles Seymour by the Presbyterian Church trustees. Seymour's widow sold the lots to Pete Valad in April of 1919, and they remained in the

possession of the Valad family through the 1930's, eventually being acquired the following decade by the Kempels.

The nature of the bridge indicated on the map of 1856 is unknown, that is, it may have been a wooden bridge, an early iron bridge, etc. It may have been a structure in 1892, than known as "Cromar's bridge", and being 124 feet (~38 metres) in length (Road and Bridge Committee 1892: 31). Or there may have been successors between 1856 and 1892. The latter was probably replaced in the twentieth century, perhaps as early as 1905, by a 125-foot (~38 metres) "riveted Pratt truss steel bridge" constructed by the Hunter Bridge & Boiler Company (Gateman 1981: 96).

2.2 Bridge Building in Ontario

Bridges in Ontario can be owned by a municipality (county, township) or the province. The Riversdale Bridge (0002) is a municipally owned bridge.

"Bridges over water courses that formed boundaries between townships were always assumed by the County. However, arguments began in the early 19th century – sometimes acrimonious – over the responsibility for building and maintaining bridges over rivers located entirely within a township. The 1866 Municipal Institutions Act stated that county councils were responsible for all bridges over 200 feet long within the county. An 1871 amendment to the Act increased this length to a remarkable 500 feet. Building such large structures was far beyond most townships financial resources. Needless to say, large bridges were relatively rare to the detriment of efficient road travel. The few major bridges constructed in this era were built by the provincial government. Fortunately, at least for townships, by 1883 the defining length of bridges had been reduced to 100 feet.

The responsibility for bridge financing became an issue again in the early 20th century. This time it was driven by the cost for building stronger bridges – not longer ones. The economic value to rural communities of good roads, and by extension good bridges, was becoming evident. Nineteenth-century wooden bridges could not carry the weight of heavier wagon and farm equipment coming into use. By the First World War, motor vehicles were becoming increasingly common and the provincial government began to provide grant programs and technical advice on bridge building. At the same time, counties began to create county-wide road networks by assuming the ownership of key township roads and bridges....

The technical evolution of bridge designs ran parallel to the economic need for good roads. In southern Ontario most 19th century bridge were built of timber. Very short ones were beam structures; longer spans employed simple trusses, such as King and Queen Post trusses. A few iron truss bridges were built in the 1870s-1880s but were generally too costly to be widely used. Inexpensive steel trusses came into use in the 1890s and the designs were commonly used into the 1930s. The Warren pony truss [subject of this report] was a work-horse design for short span, low traffic situations. The Pratt through truss and the Warren truss dominated in the early 20th century. Somewhat less common was the double-intersection Warren truss. Unusual trusses

were used for special bridging needs such as requiring a long single span. Due to the demand for steel trusses, several specialized, local bridge companies came into existence including the Hamilton Bridge Works, Sarnia Bridge Company and the Hunter Bridge and Boiler Company, Kincardine.

Instead of building new bridges, structures were sometimes recycled as an inexpensive alternative to new construction....

Concrete began to be accepted as a bridge material by the 1920s.... In the 1930s the concrete rigid frame became one of the most widely used designs.... Concrete is the most common bridging material used today in southern Ontario and employed in a variety of designs including rigid frame and as a composite in pre-stressed and post-tensioned concrete beams” (Golder 2012: 3- 4).

2.2.1 Structure Type - Truss Bridges

Bridges are considered to be industrial sites. Bridges constructed from iron and steel are the subsequent evolution from wooden bridges. The premise was that iron and steel would not need protection from the elements and made for strong and safe structures. Often, iron and steel bridges were prefabricated by companies specializing in bridge construction. The most common bridge built between 1850 and 1925 was the metal truss bridge. The truss bridge used many small pieces to make a long truss that provided both length and strength. The arrangement of these pieces determines the type of truss bridge.

“In a metal truss, many comparatively small pieces of iron or steel are joined together in a series of triangles. These structural triangles interconnect with one another to form the complete bridge. In resisting the loads placed by gravity upon a truss bridge, each of these pieces, or members, within the structure is put in either tension or compression. If a member is in compression, then the forces acting on it tend to push it together. If it is in tension, then these forces tend to pull it apart. The main members of truss are either stiff, heavy struts or posts, or then flexible rods or bars. Stiff struts or posts are capable of withstanding both tension and compression, however, thin rods or bars are only capable of withstanding tension, and this difference provides a major clue in truss identification. On the diagrams [Figures 5 and 6]..., the main compression members are delineated with a thick, heavy line and the main tension members with a thin, light line.... The dotted lines in the diagrams indicate secondary counter-ties included in some trusses as tension members to help stiffen the structure” (Comp and Jackson 1977: 2).

The length of a truss bridge helps to establish the type of bridge, but not the number of panels. A through truss carries its traffic load level with the bottom chords. A pony truss is a through truss with no lateral bracing between the top chords. And finally, a deck truss, carries its traffic load level with the top chords (ibid).

The Riversdale Bridge is a metal 8 panel rivet-connected Pratt Through Truss, fixed, with one main span (historicbridges.org). These types of bridges were constructed from 1844 and into the 20th century (Comp and Jackson 1977: Diagram 12).

Figure 5: Truss Bridge Configuration (from Comp and Jackson 1977)

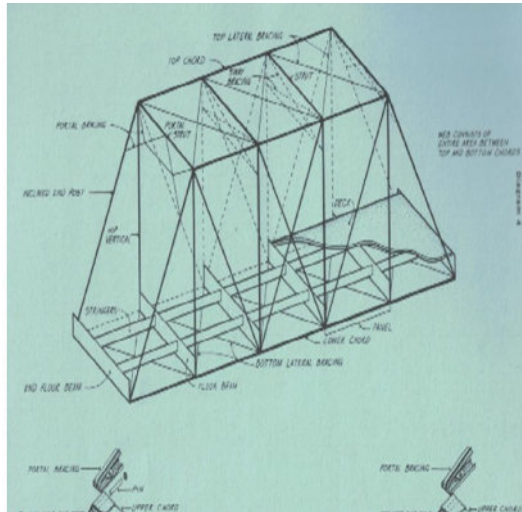


Figure 6: Pratt Truss Bridge (from Comp and Jackson 1977)

The most basic Pratt truss was first patented by Thomas and Caleb Pratt in 1844, and are characterized by the vertical members (in compression) and the diagonals (in tension) (Figure 4). This arrangement allowed for the vertical members to be reduced in size without threat of bending or buckling. The most common Pratt truss bridge in the early 20th century are the pin-connected Pratt Bridge. The Pratt half-hip (popular in the late 19th to early 20th century) had including end posts that did not horizontally extend the length of the full panel. These were used primarily in short span bridges, and usually a form of pony truss.

Another variation of the Pratt truss bridge is the Parker truss with a polygonal to chord. The arched top chord strengthens the bridge (stronger than regular Pratt truss), without adding the need for more construction materials. The size of the individual Parker Truss members, however, are not uniform as with a Pratt truss – and therefore more costly to construct.

Another form of the Pratt truss bridge is the lenticular type – while requiring less materials, the shape required a larger output to accommodate the dramatic lenticular shape.

With the advent of railroads and bridges for railroads, major improvements to the regular Pratt truss bridge were made in the 1870s with the use of sub-struts and sub-ties. These stiffened the truss allowing for increased load-carrying capacity. The railway bridges tended to be the Baltimore and Pennsylvania Pratt type bridges. Two additional Pratt truss bridges included the Kellogg (late 19th century) and the double intersection Pratt (1847 – 20th century) (ibid: 3 – 8).

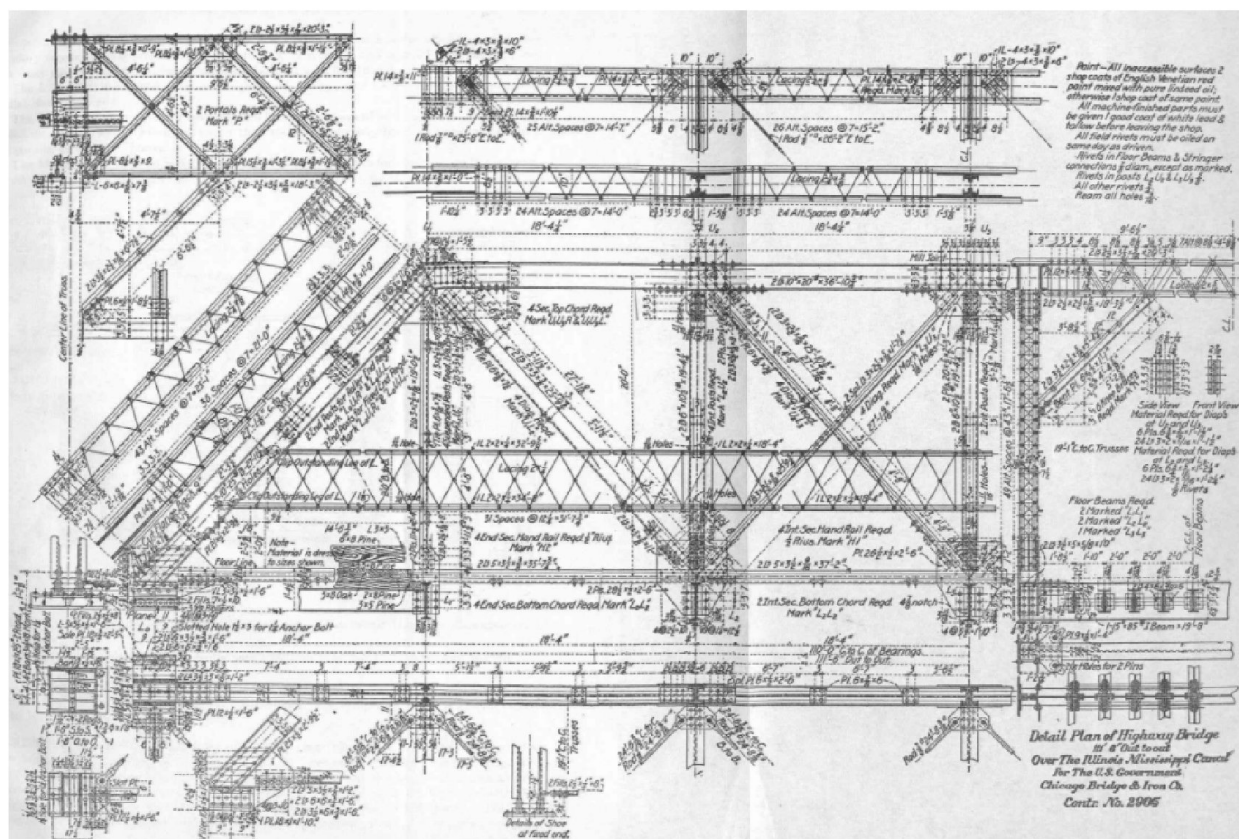
Figure 7 provides the details of a 111' 6" Pratt through span. This is presented here to demonstrate the level of engineering detail required in the construction of a Pratt through truss.

2.3 Riversdale Bridge 0002 History

Neither the County of Bruce nor the Ministry of Transportation was able to find or provide any further information regarding bridge 2-262 (Appendix E). There are, therefore, no original schematics, diagrams, blueprints or photographs of the bridge.

The nature of the bridge indicated on the map of 1856 (Figure 3) is unknown, that is, it may have been a wooden bridge, an early iron bridge, etc. It may have been a structure in 1892, than known as "Cromar's bridge", and being 124 feet (~38 metres) in length (Road and Bridge Committee 1892: 31). Or there may have been successors between 1856 and 1892. Early bridges tended to have shorter spans, and required support piers to be placed directly into the river. There was, however, no evidence of such piers, in the Teeswater River where the subject bridge now crosses.

Figure 7: Details of a 111' 6" Through Span
 (http://okbridges.wkinsler.com/technology/truss.html)



The earlier bridge was replaced in the twentieth century, most probably in 1905, by a 125-foot (~38 metres) “riveted Pratt truss steel bridge” constructed by the Hunter Bridge & Boiler Company for the sum of \$1,925.00 (Gateman 1981: 96). A truss design bridge did not require any intermediate piers, which would have been subject to the ravages of regular flooding and ice jams in the river. While Hunter Bridge and Boiler Company built the superstructure of the bridge, it is likely (although no records have been found as yet to support this supposition) that the abutments were built by another company.

The original ‘Cromer’s’ bridge had handrails raised on it, as per county minutes, in 1870. In 1892 it would seem that the original ‘Cromer’s’ bridge became unsafe and the county refused to pay for repairs. However the county received \$126 for the building of a new bridge, and in December of 1892 it is entered into the minutes that a new bridge was built over the Teeswater River north of Riversdale known as Cromer’s bridge.

The bridge that was built was 124 feet in length and was presumably made of wood as in 1899 the township council decided to replank the bridge. In 1905 the county received a second grant for two steel bridges in Riversdale and the township was given \$250.00. As there were two bridges in Riversdale, one named Cromer’s Bridge and the other Riversdale Bridge it is hard at times to discern which bridge is being discussed in the

historic record. The Cromer's Bridge is more than likely the bridge of this study as it resides on the lands just south of those owned by Mr. Cromer. As well there was an entry from 1864 which discusses a bridge being built with a toll attached to help offset the building costs when the township was low on funds. This toll caused a dispute between two local men, resulting in a jail sentence and the county revoking the toll almost immediately afterwards. The bridge that the toll was in place on was not specifically mentioned, other than being within Riversdale, however it was during the argument that the gentleman being charged stated he "should not be charged on the Queen's Highway", which is what Durham Road was sometimes referred to. As there is a provincially owned bridge on Durham road at Riversdale it is likely to assume the bridge with a toll imposed was therefore not the one of the study area, but the "South Riversdale" bridge (Gateman *ibid*).

2.3.1 Lanarkshire Steel/ Hunter Bridge and Boiler Company

The builder is currently thought as being Hunter Bridge and Boiler Company, although the website, historicbridges.org, does not list a builder but does state a horizontal member stamped with "Lanarkshire Steel Co. Scotland" (Image 1). Figure 8 illustrates the Lanarkshire Steel Co. facilities

(<https://lanarkshiresteelworks.wordpress.com/page/2/>). The stamping of certain members suggests that the material was manufactured in Scotland and shipped to Canada. The Lanarkshire Steel Company became a "public" company in April 1897, taking the same name as the previously owned private company. In 1951, it became part of the Iron and Steel Corporation of Great Britain (http://www.gracesguide.co.uk/Lanarkshire_Steel_Co). Figures 9 and 10 illustrate advertising from 1902 and 1940 for the company. While the 1940 ad is post-date of the bridge, it still presents a list of materials/services provided by the company (*ibid*).

Figure 8: Lanarkshire Steel Co. Facilities



Figure 9: 1902 Advertising

| | |
|---|--|
| The LANARKSHIRE STEEL CO., Ltd., | MANUFACTURERS OF SLABS, BLOOMS, & BILLETS. ROLLED JOISTS & BEAMS MILD STEEL BARS, ANGLES, TEES, CHANNELS, ZEDS, BULBS, and BULL TEES, by Siemen's (Acid) Process. <i>Guaranteed to pass Admiralty, Lloyd's, Board of Trade, Bureau Veritas,</i> <i>Indian State Railway, and other tests.</i> |
| MOTHERWELL, N.B. Telegrams : "SIEMENS, MOTHERWELL." | BRANDS. BOILER   STEEL. SHIP  STEEL. |

Figure 10: 1940 Advertising

STEEL JOISTS
SECTIONS & PLATES.
 ALSO
 STRUCTURAL STEELWORK.

MANUFACTURERS BY
 SIEMENS OPEN
 HEARTH PROCESS
 OF



STEEL MANUFACTURED TO
 ADMIRALTY, WAR OFFICE, AIR FORCE, HOME, COLONIAL, AND
 FOREIGN GOVERNMENTS' & RAILWAYS' REQUIREMENTS, BRITISH
 STANDARD SPECIFICATIONS, AND TO THE SURVEY OF BOARD OF
 TRADE, LLOYDS, BRITISH CORPORATION, BUREAU VERITAS, &c.

PRODUCTS INCLUDE :—
 ROLLED STEEL JOISTS, CHANNELS, ANGLES, BULB ANGLES,
 TEES, ZEDS, ROUNDS, SQUARES, FLATS,
 BRIDGE RAILS, SHIP AND TANK PLATES,
 BOILER PLATES, FORGING BLOOMS AND
 SLABS, BUILT SOLID STEEL STANCHIONS
 AND STRUCTURAL STEELWORK, STEEL
 COLLIERY ARCHES.

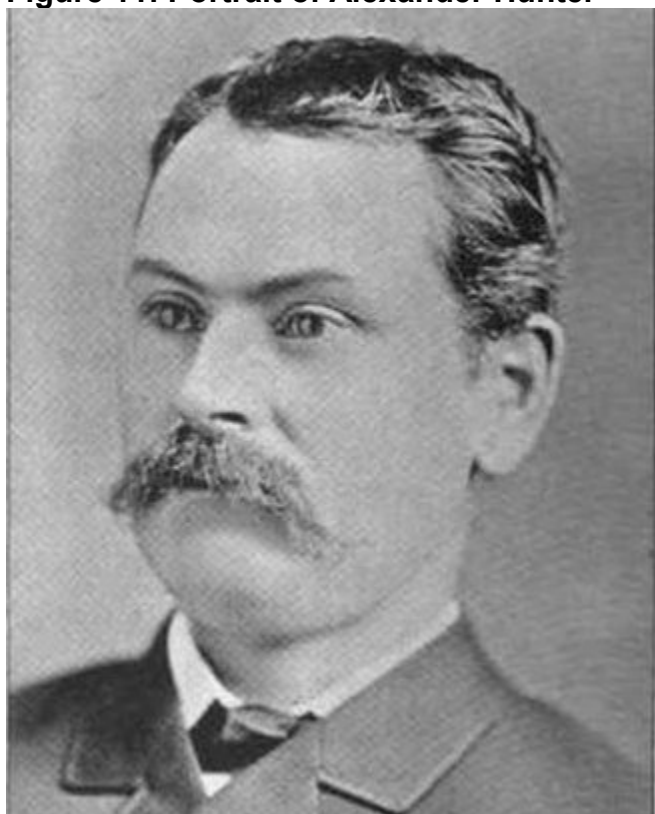
**THE LANARKSHIRE
STEEL CO. LTD.**

WORKS & REGISTERED OFFICES :
 FLEMINGTON, MOTHERWELL.
 BRANCHES AT :
 6, SPRING GARDENS, COCKSPUR ST., LONDON,
 E.C. 2.
 41, ST. VINCENT PLACE, GLASGOW, S.S.
 40, KING STREET, MANCHESTER.
 11, WESTGATE ROAD, NEWCASTLE-ON-TYNE.



The tender of Hunter Bridge and Boiler Company, based out of Kincardine, was accepted to build the Riversdale North Bridge in 1905 (Gateman 1981; 96). "Alexander Hunter, of the Kincardine Boiler and Bridge Works, was born in 1851, in Brant County, Ont. He learned the trade of boilermaker in Kincardine, where, as a skilled workman, he had charge of the shops. He afterwards worked in some of the best and largest shops in Canada. In 1887, he entered into partnership with his brother Robert... and since then they have erected many of the finest bridges in Canada" (Cochrane 1898: 102). The Hunter brothers also produced boilers. Alexander Hunter was a Methodist, and a Conservative. He was a member of the C.O.F., L.O.L and the Black Knights. His wife was Ms. Emma Fisher (married in 1872). Figure 11 illustrates a portrait of Alexander Hunter.

Figure 11: Portrait of Alexander Hunter



"Robert Hunter, senior member of the firm Hunter Brothers, Kincardine, Ont., was born near Brantford, Ont., in 1846, where his parents, James and Jane (Elliott) Hunter, of Irish birth, located about the year 1830. In 1856, they removed to Bruce County, Mr. Hunter (Figure 12) being the seventh son of a large family. The medical profession was chosen for him, but his desire was to be a mechanic. In 1862, he began his apprenticeship, and has since had a vast experience, having travelled very extensively in the United States and Canada. In 1887, with his brother Alexander, he established the Kincardine Boiler and Bridge Works; each brother is a specialist, our subject being a skilled draughtsman and master mechanic, giving attention to the building of all kinds of steel and iron bridges, boilers, etc. He is a member of the A.F. & A.M., also L.O.L. In

religion, a Methodist, in politics, a Conservative. In 1867, he married Isabella, daughter of the late Wm. Johnson, of the township of Goderich. His family consists of one son" (Cochrane 1898: 102).

Figure 12: Portrait of Robert Hunter



3.0 ARCHAEOLOGICAL ASSESSMENT

A Stage 1 archaeological assessment was conducted by Scarlett Janusas Archaeology Inc. (P027-0315-2017) in 2017 which included a larger area (but encompassed the current study area) to allow for possible related infrastructure development. The results determined that archaeological potential exists for both “Native and Euro-Canadian” archaeological resources in parts of the study area. Parts of the study area included the roadway (low potential), and permanently wet areas (low potential). For those areas (excluding those of low archaeological potential) a Stage 2 archaeological assessment was recommended.

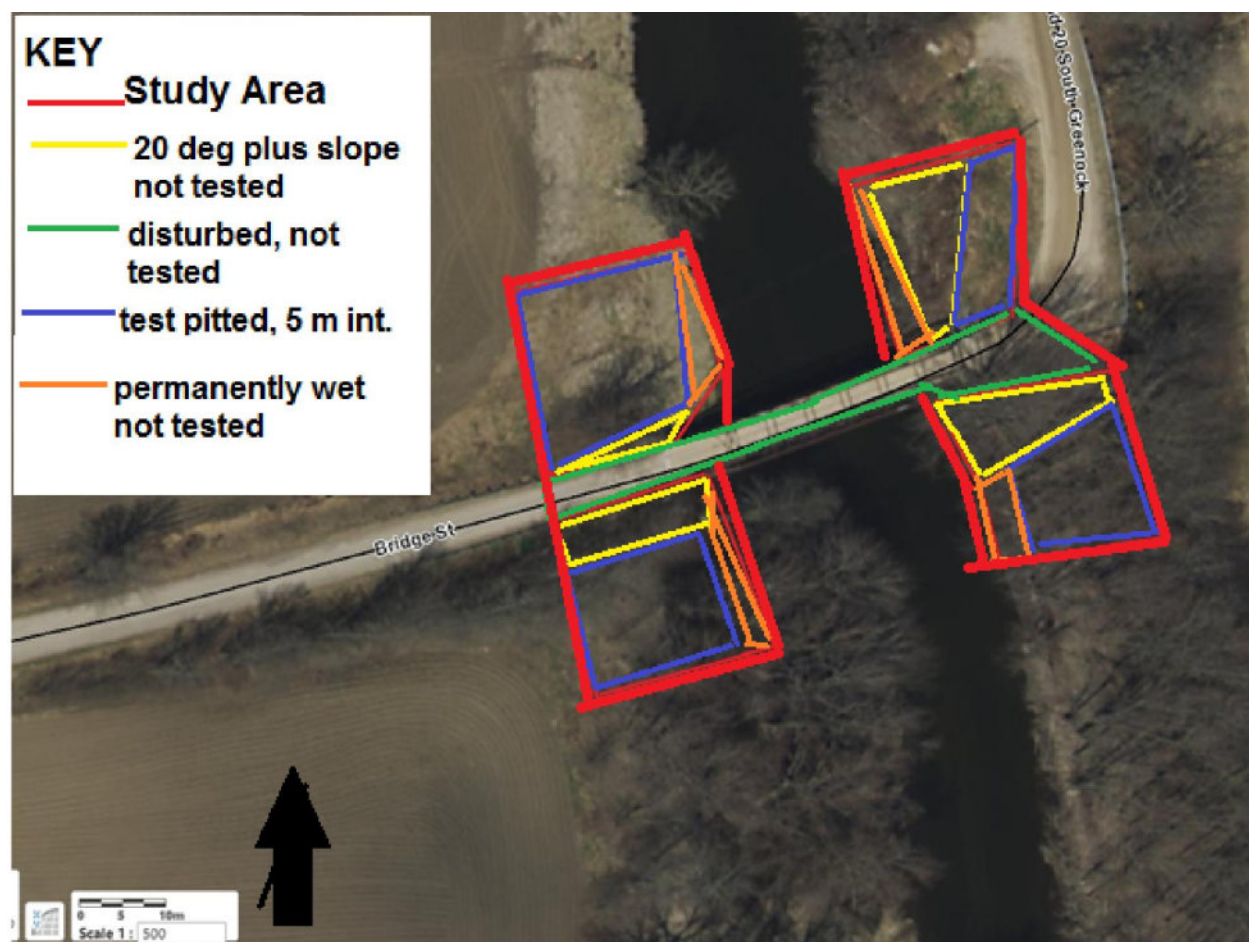
There are no registered archaeological sites located within one kilometre of the study area (from 2017 access to the site database). Soils consisted of bottomland and muck. There were no commemorative plaques in the area. Topography in the area is flood plain with a rise to higher elevations away from the river. There are no appreciable banks for the Teeswater River in this area. A property inspection also formed part of the Stage 1 archaeological assessment report.

The Stage 2 archaeological assessment (Figure 13) was conducted by Scarlett Janusas Archaeology Inc. (P027-0317-2017). The assessment was conducted on May 6th, 2017 under appropriate lighting and weather conditions using a test pitting methodology. An area of 20 metres by 20 metres was assessed at the four corners of the bridge. No archaeological sites were located during the Stage 2 assessment. Figure 14 illustrates the archaeological methodology conducted for the area with negative results. The recommendation for the study area was that no further archaeological assessment was required, however, in the event of discovery of deeply buried archaeological resources, that development activities be halted, and a licenced archaeologist be retained to address the archaeological resources.

Figure 13: Area of Stage 2 Archaeological Assessment



Figure 14: Stage 2 Archaeological Methodology



4.0 CULTURAL HERITAGE LANDSCAPE DESCRIPTION

4.1 Area Context

Bruce County is largely rural in character. It consists of several main towns such as Walkerton, Southampton, Kincardine, Wiarton and numerous small village and settlement nodes set in rural agricultural land. The County seat is Walkerton on the Saugeen River about 75 kilometres southwest of Owen Sound. A network of county and local township roads provides access in the area, while three provincial highways run through the County (Highways 6, 9, and 21). The Municipalities of Northern Bruce Peninsula, Town of South Bruce Peninsula and Town of Saugeen Shores are located in the northern part of the county, while the southern part of the County is occupied by the Municipalities of Arran-Elderslie, Brockton, Kincardine and the Township of Huron-Kinloss. The Municipality of Brockton includes the former geographic Townships of Brant and Greenock.

The study area lies in the physiographic region known as the Guelph Drumlin Field. This area is characterized by broad, oval drumlins composed of loamy and calcareous till, derived from dolostone as well as some fragments of red shale. This region occupies a total area of approximately 829 square kilometers and is centered on the City of Guelph (Chapman and Putnam 1984:137). Recorded at between 304.8 meters and 426.72 meters above sea level, the drumlins of this region are underlain with Amabel and Guelph rock formations, fringed by gravel terraces and separated from one another by valleys with swampy bottoms (*ibid*). The elevation of the terrain within the study area ranges from

The elevation of the terrain within the study area ranges from 270 to 271 metres above sea level. The topography of the surrounding area is varied, with agricultural lands to the north, east and northeast, and to the south and southwest, floodplain and permanently wet areas. Along the west side of the river is floodplain, rising up to residential properties. The Teeswater River has a length of about 75 kilometres and empties into the Saugeen River.

Mr. R. Walsh surveyed the Township of Greenock in 1852, however it was not until September 27th, 1854 that the Crown sold the lands, excepting the free grants, during the “big land sale”. A. P. Brough, P.L.S. surveyed the Durham road. Greenock settlement was slow to start, and there were no roads going east and west through the county due to the large swampland at its centre. Many bridges and roads were constructed in later years to aid in travel across the county, and at one point talk of dredging “Mud River” or Teeswater River was undergone to improve the flood plains drainage (Norman Robertson 1904: 401-407). The nearest village to the bridge is Riversdale, which primarily lies on the west side of the Teeswater River.

4.2 Site Description

For the purposes of this study, the Riversdale Bridge is considered to run in a west-east direction. It forms part of Bridge Street and becomes Sideroad 20. It is located on Bridge Street approximately 472 metres north of Highway 9, and 1.57 km south of

Sideroad 2. West of the bridge, Bridge Street is a two-lane tar and gravel roadway with posted with a 50 km/hour speed limit. At the east end of the bridge, the road (Sideroad 20) becomes a two-lane dirt road, with no posted speed limit. The Teeswater River not signed. It flows in an approximate south to north direction at the subject bridge.

The vicinity of the bridge is mostly forested, although the northwest area of the bridge is agricultural. There is a steep slope down to the rivers' edge at all four corners. There are no adjacent built properties (Figure 15). The topography, above the rise of the river banks is generally level.

Figure 15: Aerial Photograph Illustrating Cultural Heritage Landscape



Images 2 to 5 illustrate the surrounding topography of the subject bridge, including approaches to the bridge. Images 22 and 23 illustrate viewsheds from the centre of the bridge.

5.0 BUILT HERITAGE DESCRIPTION

5.1 Existing Bridge

The internet site, historicbridges.org, has a list of North American bridges, including Ontario bridges. It lists the Riversdale Bridge as having a national significance of 7 and a local significance of 6. [Historicbridges.org](http://historicbridges.org) is not for profit website which strives for accuracy in recording and documenting any all bridges pre 1970, with the exception of wood covered bridges. They have no government affiliation and strive for accuracy however they cannot guarantee it. The organization uses an amalgamation of the United States National Rating system, Canadian Federal and provincial legislature, and even some European (mainly from the United Kingdom) guidelines to create their rating scale. The rating scale on the website is divided into two categories, National Historic Rating and local Historic Rating. The National Historic rating is based on the above mentioned legislatures, and the technological significance of the Bridge. As the specifications are more design based, very few of the bridges on the website can score above 8 or below 2 on the National Historic Scale. It is the websites' belief that every bridge built prior to 1970 (as that year saw the standardization of bridges in uniformity and construct) have some historic value to the country at large, therefore only those post 1970 would receive a 0 rating, unless they are unique or of great local importance. The Local Historic Rating is much more ambiguous. It will allow a bridge to receive a higher rating based on the engineer, design and materials in relation to the localized area. An example would be a common concrete bridge of which thousands exist in good standing, receiving a higher rating of say 8 out of 10 as it is the only bridge at all or of that kind in a small town or village. As it is not in any way unique or rare when compared to bridges on a national scale, the final rating for a mundane bridge could have a rating as follows: 2 out of 10 National Historic Rating and 8 out of 10 Local Historic Rating.

[Historicbridges.org](http://historicbridges.org) states: *"The HSR (Historic Rating Scale) is designed to show that some bridges are more important than others, while also showing that bridges that are not as rare still indeed have historic value, and should be considered for preservation."* As this is the case the website is considered an excellent reference tool however the HSR should only be regarded as community or individual thought, and not as a definitive scale of findings.

The website, above, identified the subject bridge as a metal, 8 panel, rivet-connected Pratt Through Truss, fixed, with one span. The builder is unknown. Some of the bridge elements come from the Lanarkshire Steel Company, in Scotland, as evidenced by stamping (Image 1).

The existing bridge measures 125', and is a riveted Pratt truss steel bridge. It is described as "a fairly light weight rivet-connected bridge" (www.historicbridges.org). There are no known existing drawings for the bridge or no historic photographs have come to light with this research.

The primary difference between a Warren and a Pratt truss are the verticals in a Pratt (the subject bridge) are that the verticals are in compression, rather than the diagonals. This makes the verticals have a “heavier” visual appearance.

Images 1, 3 to 21 illustrate the bridge in its current state.

5.1.1 Approaches

Both approaches to the bridge have been subject to some cut and infilling, and both lead to the bridge as it crosses the Teeswater River. The approaches are both very level. The east approach to the bridge begins as Bridge Street, a two-lane, tar and gravel road. The deck of the bridge is wood, and then the road curves towards the north where it becomes a two lane dirt road-Sideroad 20. The road on both sides of the bridge has been built up to ensure clearance of the river (Images 2 - 4).

5.1.2 Abutments

The abutments are constructed of cast-in-place concrete and built into the steep sloping embankments of the river. It is unknown who built the abutments, but it was likely another construction company other than Hunter Bridge and Boiler Company. The concrete abutments are winged back at about a 45 degree angle to the bridge deck (Images 8 – 14, 25). All four abutments show signs of deterioration. Image 13 shows the impressions of shoring, or wooden framework, used for construction of the abutments.

5.1.3 Truss

The subject bridge consists of a single span of 125', 16' 4.38" (5 metre) total bridge width and a 14' (4.30 m) deck with open railing barriers on both sides of the bridge.

The subject bridge consists of an upper chord in compression, and a lower chord both on compression and in tension, connected by vertical and diagonal members. The two trusses consist of eight main panels. The top chords and end posts were constructed of two steel channels separated with riveted top plates and very basic lattice girder (Image 18 and 20). The subject bridge has a sloped and braced portal frame at both ends.

The vertical posts were constructed as riveted lattice beams. The bottom chords were assembled from steel channels separated with plates at intervals along the beam. The diagonals are constructed of sets of angle bars separated with riveted plates. There is very basic sway bracing (Images 2, 4 7, and 17). The trusses were assembled with riveted top chord connections and pin connections at the bottom chords.

The upper frame work has been subject to repair (Image 17) at the east end with the replacement bracing. Examples of the upper and lower chords are presented in Images 18 to 20.

5.1.4 Deck

The wooden deck is supported by cross beams that are riveted to the bottom chords of the two trusses. These beams support the steel I-beam that runs the length of the bridge. Pipe railings are fastened to the trusses on either side of the bridge, but are generally in poor repair. The railing has been repaired on the north side (Image 15) and Image 16 illustrates a broken and neglected piece of railing. A modern steel guard rail runs the length on both sides of the bridge. Parts of the deck (constructed with 2" x 6" wooden planks placed side by side rather than end to end for strength) are worn, but superficially, the deck appears sound (Image 6). This is most likely not the original decking.

5.1.5 Condition & Modifications

A bridge inspection was conducted on July 3rd 2014 (Appendix A/Palmay 2015). Specific details are presented in the appendix, and the summary indicates the following:

"The structure appears to be in overall fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed (noted since the 2007 report), and appears to be in overall fair condition and structurally adequate. The concrete substructure appears to be in overall poor condition with severe to very severe cracking, spalling and delamination. The overall stability of the concrete abutments and wingwalls is questionable. The severe vertical crack through the northwest wingwall was identified in the 2005 report. Although the crack does not appear to be getting larger, failure of this wingwall will cause the single lane approach to slump which will require closure of the road to repair.

Recommendations:

1. Clean truss seats (within 2 years).
2. Replace missing posts, bearing blocks, and repair damaged areas of approach guiderails (within 2 years).
3. Replace missing warning sign in south east corner (within 5 years).
4. Replace structure within 5 years" (Palmay 2015).

There appears to have been no major modifications made to the bridge. Maintenance has been conducted with the replacement and partial repair of the handrail and some bolted repairs and replacements of both diagonal members and portal bracing of the subject bridge (Image 26). The deck of the bridge has likely been replaced at least once since its initial construction. A deck repair (no date provided) was conducted by the County of Bruce (Appendix E). The concrete abutments show signs of deterioration common in concrete construction. The majority of the bridge retains historic integrity of both materials and design.

5.2 Adjacent Structures

There are no adjacent structures (Figure 15).

5.3 Comparative Analysis

5.3.1 Municipal

There are five bridges in Bruce County (including the subject bridge) listed under historicbridges.org which have been identified as Pratt Rivet-connected bridges. These include the 12th Brant Bridge; Big Irwin Bridge; Old CR-3 Bridge, the Watson Bridge, and the Riversdale Bridge. The 12th Brant Bridge is a combination Warren and Pratt bridge. Big Irwin Bridge and Watson Bridge are seven panel bridges, whereas Riversdale is an 8 panel bridge. Old CR-3 bridge is an 8 panel bridge with two spans, where Riversdale is a single span bridge.

According to the website, historicbridges.org, Bruce County has an “unusually large collection of riveted truss bridges” of single span. While the latter may be true of all riveted truss bridges (there are several types), only the Riversdale Bridge is the single example of a single span *Pratt rivet-connected* bridge in Bruce County.

The Riversdale Bridge is not included on a municipal heritage register as a registered property or as a municipally designated property under Part IV or Part V of the OHA and is not protected by a municipal heritage easement.

The subject bridge is not the subject of an Ontario Heritage Trust easement or commemorative plaque.

5.3.2 Provincial

The provincial heritage bridge inventory no longer exists. All properties, including bridges, owned and/or controlled by the Province and identified as having cultural heritage value would be included on the list of provincial heritage properties maintained by the Ministry of Tourism, Culture and Sport (Part III.1 of the Ontario Heritage Act). At this time, there is no heritage bridge identified in the Bruce County area (Herczeg 2018).

The website, historicbridges.org was used to determine if there were any similar bridges located in listed counties. There are 40 Pratt rivet-connected bridges located in the province of Ontario according to the website historicbridges.org. Of these, there were only eight (including the subject bridge) that were 8 panel Pratt rivet-connected bridges. The following presents data regarding these bridges.

Table 1: Comparative Analysis for 8 Panel Rivet-Connected Through Truss Bridges

| County | Bridge Name | Builder | Date of Construction |
|-------------------------------|-----------------|---|----------------------|
| Bruce | Riversdale | Unknown | Ca. 1905 |
| Muskoka | Stephenson Road | Central Bridge and Engineering Company of Peterborough and Wm. H. Law of Peterborough | 1892 |
| Lanark/Leeds-Grenville | Andrewsville | Dominion Bridge Co. of Montreal | Ca. 1900 |

| | | | |
|-------------------|-------------------------------|--|---------|
| Oxford | TR-12 Bridge Middle | Reid-Riddell Engineers of Toronto | 1929 |
| Oxford | TR-2 | Unknown | Unknown |
| Waterloo | Hartman | Hamilton Bridge Company of Hamilton | 1910 |
| Waterloo | | Canadian Bridge Co. of Walkerville | 1955 |
| Wellington | Minto Normanby Townline | Unknown | unknown |

5.3.3 Federal

The Canadian Register of Historic Places (CRHP) provides a single source of information about all historic places recognized for their heritage value at the local, provincial, territorial and national levels throughout Canada. The Register contains 18 bridges, but none are Pratt rivet-connected through truss bridges.

5.3.4 Conclusion

The Riversdale Bridge is an example of a single span Pratt rivet-connected bridge, the only one of its specific kind in Bruce County.

There are seven similar bridges in Ontario in Muskoka, Lanark/Leeds-Grenville (listed in both but same bridge), Oxford, Waterloo, and Wellington Counties.

The Riversdale Bridge is not recognized as being of municipal, provincial or federal heritage value.

6.0 CULTURAL HERITAGE RESOURCE EVALUATION

6.1 Introduction

The criteria for determining cultural heritage value or interest were set out under Ontario Regulation 9/06 made under the OHA, as amended in 2005. These criteria were developed to assist municipalities in the evaluation of properties considered for designation. The regulation states:

“A property may be designated under section 29 of the Act if it meets one or more of the following criteria for determining whether it is of cultural heritage value or interest:

1. *The property has design value or physical value because it,*
 - i. *is a rare, unique, representative or early example of a style, type, expression, material or construction method,*
 - ii. *displays a high degree of craftsmanship or artistic merit,*

or

 - iii. *demonstrates a high degree of technical or scientific achievement.*
2. *The property has historical value or associative value because it,*
 - i. *has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community,*
 - ii. *yields, or has the potential to yield , information that contributes to an understanding of a community or culture, or*
 - iii. *demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community.*
3. *The property has contextual value because it,*
 - i. *is important in defining, maintaining, or supporting the character of an area,*
 - ii. *is physically, functionally, visually or historically linked to its surroundings,*

or

 - iii. *is a landmark.”*

The Riversdale Bridge is an example of a single span Pratt rivet-connected bridge, the only one of its specific kind in Bruce County.

There are seven similar bridges in Ontario in Muskoka, Lanark/Leeds-Grenville (listed in both but same bridge), Oxford, Waterloo, and Wellington Counties.

The Riversdale Bridge is not recognized as being of municipal, provincial or federal heritage value.

6.2 Evaluation

The “Criteria for Determining Cultural Heritage Value or Interest” set out in Ontario Regulation 9/06 under the OHA was applied to the Riversdale Bridge to determine its cultural heritage value or interest. The results are contained in Table 2 and in associated text descriptions.

Table 2: Evaluation Under “Criteria for Determining Cultural Heritage Value or Interest”, Ontario Regulation 9/06

| Criterion | Response | Analysis |
|--|-----------------|---|
| Design/Physical Value | | |
| i. Rare, unique, representative or early example of a style, type, expression, material or construction method. | Yes | <p>The subject bridge was built circa 1905, and has been subject to mediation repairs to the handrail, upper bracing and bolts. Pratt Through Truss Bridges are representative of early 20th century bridge construction. It's one of only five in Bruce County, and the only one with 8 panels and a single span. According to historicbridges.org, metal rivet-connected through truss bridges are not considered to be rare in Bruce County.</p> <p>The bridge exhibits deterioration of the concrete but the character of the bridge remains intact.</p> |
| ii. Displays a high degree of craftsmanship or artistic merit. | No | It does have a moderate degree of craftsmanship. |
| iii. Demonstrates a high degree of technical or scientific achievement. | No | There is no great degree of technical or scientific achievement associated with the subject bridge. |
| Historical or Associative Value | | |
| i. Has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community. | Yes | <p>Theme: a bridge crossing was probably first established in this location concurrent with the settling of the village of Riversdale. The earlier bridge was replaced in the twentieth century, most probably in 1905, by a 125-foot (~38 metres) “riveted Pratt truss steel bridge” constructed by the Hunter Bridge & Boiler Company for the sum of \$1,925.00.</p> <p>The original ‘Cromer’s’ bridge had handrails raised on it, as per county minutes, in 1870. In 1892 it would seem that the original ‘Cromer’s’ bridge became unsafe and the county refused to pay for repairs. However the county received \$126 for the building of a new bridge, and in December of 1892 it is entered into the minutes that a new bridge was built over the Teeswater River north of Riversdale known as Cromer’s bridge.</p> <p>In 1905 the county received a second grant for two steel bridges in Riversdale and the township was given \$250.00. The Cromer’s Bridge is more than likely the bridge of this study as it resides on the lands just south of those owned by Mr. Cromer.</p> |

| Criterion | Response | Analysis |
|--|----------|---|
| | | The early bridge served as a general transportation route and one serving the local agricultural community where produce and livestock would have been transported to towns via the bridge. |
| ii. Yields, or has the potential to yield information that contributes to an understanding of a community or culture. | Yes | The bridge was built ca. 1905, and was used by local residents to cross the river and may have played a role in the local community both in terms of access to social visiting and family ties, as well as economically, through the transportation and distribution of goods using the bridge as a conduit to points south or north of the river. |
| iii. Demonstrates or reflects the work or ideas of an architect, artist, builder, designer or theorist who is significant to a community. | Yes | The builder of the current bridge is Hunter Bridge and Boiler and built ca. 1905. "Alexander Hunter, of the Kincardine Boiler and Bridge Works, was born in 1851, in Brant County, Ont. He learned the trade of boilermaker in Kincardine, where, as a skilled workman, he had charge of the shops. He afterwards worked in some of the best and largest shops in Canada. In 1887, he entered into partnership with his brother Robert... and since then they have erected many of the finest bridges in Canada" (Cochrane 1898: 102) |
| Contextual Value | | |
| i. Is important in defining, maintaining, or supporting the character of an area. | Yes | The bridge served as a conduit to points north of the village of Riversdale and also to the east and west of the Teeswater River prior to the bridge being built along Highway 9. |
| ii. Is physically, functionally, visually or historically linked to its surroundings. | Yes | The bridge contributes to the landscape character of the area, emphasizing its former function to serve as a conduit to areas on either side of the Teeswater River. |
| iii. Is a landmark. | No | The definition of a landmark is: an object or feature of a landscape or town that is easily seen and recognized from a distance, especially one that enables someone to establish their location (www.oxforddictionaries.com). The subject bridge is a local landmark, but is not visible from the well-travelled Highway 9 which lies south of the bridge. |

6.2.1 Design Value

The Riversdale Bridge is representative of an early style of bridge. The Riversdale Bridge is a metal 8 panel rivet-connected Pratt Through Truss, fixed, with one main span (historicbridges.org). The most common bridge built between 1850 and 1925 was the metal truss bridge. The truss bridge used many small pieces to make a long truss that provided both length and strength. The arrangement of these pieces determines the type of truss bridge. The Pratt through truss and the Warren truss dominated bridge construction types in the early 20th century.

Due to the demand for steel trusses, several specialized, local bridge companies came into existence including the Hamilton Bridge Works, Sarnia Bridge Company and the Hunter Bridge and Boiler Company, Kincardine.

Farago (1990: 555) indicates that in 1990 there were "...3251 structures on the provincial road system in Ontario, 2455 are concrete and 796 are steel. Of these only 106 are truss bridges. ...". Of these, only 45 were built prior to 1940. This does not include municipal bridges.

There are 40 Pratt rivet-connected bridges located in the province of Ontario according to the website historicbridges.org. Of these, there were only eight (including the subject bridge) that were 8 panel Pratt rivet-connected bridges. The Riversdale Bridge is evaluated on the website as having a national significance of 7, and a local significance of 6.

There are five bridges in Bruce County (including the subject bridge) listed under historicbridges.org which have been identified as Pratt Rivet-connected bridges. These include the 12th Brant Bridge; Big Irwin Bridge; Old CR-3 Bridge, the Watson Bridge, and the Riversdale Bridge. The 12th Brant Bridge is a combination Warren and Pratt bridge. Big Irwin Bridge and Watson Bridge are seven panel bridges, whereas Riversdale is an 8 panel bridge. Old CR-3 bridge is an 8 panel bridge with two spans, where Riversdale is a single span bridge.

The subject bridge was built ca. 1905, and there have been obvious maintenance repairs that have been made to the bridge, although these appear to be moderate in scope. The bridge exhibits deterioration of the concrete faces of the abutments, but the character and integrity of the bridge is still apparent.

The subject bridge type, steel truss bridge, is not rare in Bruce County or the province, however, there are few with 8 panels of the rivet-connected Pratt through truss type. The bridge is considered representative of an early example of a style, type, material and construction method.

The Riversdale Bridge displays a only a moderate degree of craftsmanship or artistic merit.

Bridge construction does not demonstrate a great degree of technical or scientific achievement.

6.2.2 Historical or Associative Value

The bridge is located northeast of the village of Riversdale where the Teeswater River is crossed by Durham road. In the spring of 1850, John Caskanette and Joseph Chartrand brought their families to the area. Riversdale was surveyed into village lots in 1855, at the instance of Joseph C. Chartrand, George Cromar and James Bennie; but it may date its commencement from the time a post-office was established there in 1854. George Cromar was the foremost man in the little village at that time, and continued as such until his death, which occurred in the summer of 1861. In 1857 he built a steam saw and grist mill; then the usual supply of blacksmith shops and hotels appeared one after another. In 1860 James Millar and Anthony Mason rented the mills from Mr. Cromar, and after his death purchased them from the executors of the estate. These mills may have been located close to the subject bridge (Robertson 1904: 402).

The subject bridge was constructed circa 1905. The first bridge, known as Cromar's bridge, stood in this location, but was replaced circa 1905. A bridge was noted in an 1856 map in this location, about the same time as the settlement of the village.

The early bridge served as a general transportation route and one serving the local agricultural community. The replacement bridge of circa 1905 would have continued in the same capacity. The bridge became less used with the development of Highway 9 and the concrete bridge crossing of the Teeswater River.

The current bridge was built by the Hunter Bridge & Boiler Company. It replaced the derelict (unsafe) Cromar's Bridge ca. 1905. There are no found engineering drawings or photographs of either of the bridges. The builder of the current bridge is Hunter Bridge and Boiler and built ca. 1905. "Alexander Hunter, of the Kincardine Boiler and Bridge Works, was born in 1851, in Brant County, Ont. He learned the trade of boilermaker in Kincardine, where, as a skilled workman, he had charge of the shops. He afterwards worked in some of the best and largest shops in Canada. In 1887, he entered into partnership with his brother Robert... and since then they have erected many of the finest bridges in Canada" (Cochrane 1898: 102)

The bridge demonstrates the work or ideas of a builder that is significant to the community.

6.2.3 Contextual Value

The bridge is still functional providing a conduit over the Teeswater River northeast of the village of Riversdale. The bridge does contribute to the landscape character of the area highlighting the need for a bridge for the local population to transport people, livestock and goods. The subject bridge is not, however, visible to the general public unless one takes the Bridge Road/Sideroad 20 which is located north of Highway 9.

The bridge is linked historically to its surroundings.

The development of road patterns effects the contextual value of bridges. Bridges sometimes crossed rivers at sharp angles, or were located at the base of steep slopes. This bridge likely stands where the river crossing was during the early settlement of Bruce County. The bridge achieved lesser status with the development of Highway 9 and the concrete bridge crossing south of the subject bridge. The viewsheds illustrate the agricultural aspect of the area to the north, and the natural riverside vegetation to the south (Images 22 and 23).

The bridge contributes to the landscape character of the area, emphasizing its former function to serve as a conduit across the Teeswater River in Bruce County.

The definition of a landmark is: an object or feature of a landscape or town that is easily seen and recognized from a distance, especially one that enables someone to establish their location (www.oxforddictionaries.com). The subject bridge cannot be seen from Highway 9. It can only be seen from Bridge Street and Sideroad 20. The subject bridge is not considered a landmark.

6.3 Summary of Cultural Heritage Value

It is determined through the application of the Criteria for Determining Cultural Heritage Value under Ontario Regulation 9/06, as presented above in Table 2, that the Riversdale Bridge has design and physical value, historical or associative value; and contextual value.

6.4 Statement of Cultural Heritage Value

The Riversdale Bridge is located on the Teeswater that empties into the Saugeen River at Paisley, Ontario. It is located 480 metres north of Highway 9, northeast of the village of Riversdale, on Bridge Road, which is posted as 50 km/hour. The surrounding area is rural agricultural in nature and undeveloped river bottom and wetlands.

The Riversdale Bridge is considered to exhibit cultural heritage value based on an evaluation of the bridge under “Criteria for Determining Cultural Heritage Value or Interest” as per Ontario Regulation 9/06 (see Table 2). Under Design and Physical Value, criteria i (Rare, unique, representative or early example of a style, type, expression, material or construction method) is satisfied by the following: the subject bridge was built circa 1905, and has been subject to mediation repairs to the handrail, upper bracing and bolts. Pratt Through Truss Bridges are representative of early 20th century bridge construction. It’s one of only five in Bruce County, and the only one with 8 panels and a single span. According to historicbridges.org, metal rivet-connected through truss bridges are not considered to be rare in Bruce County.

The bridge exhibits deterioration of the concrete but the character of the bridge remains intact.

Under Historical or Associative Value, criteria i (Has direct associations with a theme, event, belief, person, activity, organization or institution that is significant to a community), ii (Yields, or has the potential to yield information that contributes to an understanding of a community or culture), and iii (Demonstrates or reflects the work or

ideas of an architect, artist, builder, designer or theorist who is significant to a community) are satisfied by the following: i) Theme: a bridge crossing was probably first established in this location concurrent with the settling of the village of Riversdale. The earlier bridge was replaced in the twentieth century, most probably in 1905, by a 125-foot (~38 metres) “riveted Pratt truss steel bridge” constructed by the Hunter Bridge & Boiler Company for the sum of \$1,925.00.

The original ‘Cromer’s’ bridge had handrails raised on it, as per county minutes, in 1870. In 1892 it would seem that the original ‘Cromer’s’ bridge became unsafe and the county refused to pay for repairs. However the county received \$126 for the building of a new bridge, and in December of 1892 it is entered into the minutes that a new bridge was built over the Teeswater River north of Riversdale known as Cromer’s bridge.

In 1905 the county received a second grant for two steel bridges in Riversdale and the township was given \$250.00. The Cromer’s Bridge is more than likely the bridge of this study as it resides on the lands just south of those owned by Mr. Cromer. The early bridge served as a general transportation route and one serving the local agricultural community where produce and livestock would have been transported to towns via the bridge; ii) The bridge was built ca. 1905, and was used by local residents to cross the river and may have played a role in the local community both in terms of access to social visiting and family ties, as well as economically, through the transportation and distribution of goods using the bridge as a conduit to points south or north of the river; and, iii) The builder of the current bridge is Hunter Bridge and Boiler and built ca. 1905. “Alexander Hunter, of the Kincardine Boiler and Bridge Works, was born in 1851, in Brant County, Ont. He learned the trade of boilermaker in Kincardine, where, as a skilled workman, he had charge of the shops. He afterwards worked in some of the best and largest shops in Canada. In 1887, he entered into partnership with his brother Robert... and since then they have erected many of the finest bridges in Canada” (Cochrane 1898: 102).

Under Contextual Value, criteria i (Is important in defining, maintaining, or supporting the character of an area) is satisfied as follows: The bridge served as a conduit to points north of the village of Riversdale and also to the east and west of the Teeswater River prior to the bridge being built along Highway 9.

There are five bridges in Bruce County (including the subject bridge) listed under historicbridges.org which have been identified as Pratt Rivet-connected bridges. Of the bridges, only two are 8 panel Pratt bridges. Old CR-3 bridge is an 8 panel bridge with two spans, where Riversdale is a single span bridge.

The subject bridge was built circa 1905, and moderate maintenance repairs have been made over time to the bridge. It retains its reinforced, cast-in-place concrete abutments and the subject bridge consists of an upper chord in compression, and a lower chord both on compression and in tension, connected by vertical and diagonal members. The two trusses consist of eight main panels. The top chords and end posts were

constructed of two steel channels separated with riveted top plates and very basic lattice girder. The subject bridge has a sloped and braced portal frame at both ends. The nature of the probably earliest bridge indicated on the map of 1856 is unknown, although, it may have been a wooden bridge or an early iron bridge, etc. It was probably the same structure (or replaced) of 1892, then known as “Cromar’s bridge”, and being 124 feet (~38 metres) in length (Road and Bridge Committee 1892: 31). Or there may have been successors between 1856 and 1892. The latter was probably replaced in the twentieth century, perhaps as early as 1905, by a 125-foot (~38 metres) “riveted Pratt truss steel bridge” constructed by the Hunter Bridge & Boiler Company (Gateman 1981: 96).

The 113-year-old Riversdale Bridge is physically, functionally, visually, and historically linked to its surroundings. Bridges have been built at this location from the mid-19th century onwards. The bridge served as part of the early settlement roads of Bruce County, prior to having a less impact with the development of Highway 9 to the south. The name of the bridge is taken from the adjacent historical 19th century hamlet of Riversdale.

The following heritage attributes listed in Section 6.5 below must be retained to conserve the CHVI.

6.5 Description of Heritage Attributes

The character defining heritage attributes of the Riversdale Bridge include, but not limited to:

- steel truss bridge the rivet-connected Pratt through truss type
- timber deck beams
- 8 panel design
- Rivet-connected skeletal framework, including diagonal steel members and horizontal bracing
- Location spanning the Teeswater River in a rural setting
- Location on a rural road at the edge of the village of Riversdale
- reinforced, cast-in-place concrete abutments.

6.6 Conclusion

The cultural heritage evaluation report has determined that the subject bridge (Riversdale, No. 002 (MTO ##2-262), located on Bridge Street/Sideroad 20, between lots 30 and 31, Concession 1 NDR (north of the Durham Road), former geographic township of Greenock, now the Municipality of Brockton, Bruce County, meets one or more of the evaluation criteria under “Criteria for Determining Cultural Heritage Value or Interest” under Ontario Regulation 9/06. Based on the evaluation of these criteria, the subject bridge is considered to be of cultural heritage value or interest, and is therefore “worthy of consideration” by the municipality for registering the bridge on a municipal heritage register or to municipally designated the structure under Part IV of the Ontario Heritage Act.

The cultural heritage evaluation was conducted to determine the appropriate Project Schedule of the Environmental Assessment process that will be required to address the existing structural deficiencies for the aging bridge located in Riversdale, within the Municipality of Brockton, Bruce County.

As set out in the MCEA Checklist, Part C – Heritage Assessment, and because of its evaluation of having cultural heritage or interest, a Heritage Impact Assessment has been included as part of this report.

The Heritage Impact Assessment (HIA) assesses the impacts of the proposed bridge remediation (preferred option indicated by the Municipality).

7.0 CULTURAL HERITAGE IMPACT ASSESSMENT

The County of Bruce has expressed that they would like to see the remediation of the bridge due to continuing deterioration of the bridge.

7.1 Mitigation Recommendations

Mitigation options are based solely on heritage values and do not include considerations of load-capacity, etc. These technical considerations and other “environments” assessed through the MCEA process need to be evaluated by an engineer or similar professional and coupled with the following mitigation options, may present a clear direction.

The bridge has been evaluated as having cultural heritage value and interest. The Pratt Truss through steel bridge replaced an earlier bridge, of which there are no apparent remnants. There are deterioration problems evident on the bridge, but rehabilitation of a similar bridges demonstrates that repairs can be made to the bridge.

Bridge improvement alternatives presented herein are based solely on heritage values and are to be considered within the context of the overall EA process. The following options include seven conservation options and two for the complete removal or replacement of the bridge. They are presented in order of priority, where alternative 1 should be considered before alternative 2, and so on. Bridge replacement or removal does not preclude these alternatives as mitigation measures can be implemented to address heritage concerns regardless of the alternative selected (for example, new construction). New construction can be configured to reflect heritage concerns, retention of the existing structure or elements thereof might be a consideration:

1. retention of existing bridge with no major modification undertaken;
2. restoration of missing or deteriorated elements where physical or documentary evidence can be used for their design
3. retention of existing bridge with sympathetic modification;
4. retention of existing bridge with sympathetically designed new structure in proximity to existing location;
5. retention of existing bridge no longer in use for vehicular purposed but adapted for pedestrian walkaways, cycle paths, scenic viewing, etc.;
6. retention of bridge as heritage monument for viewing purposes only;
7. relocation of bridge to appropriate new site for continued use (see 4) or adaptive re-use (see 5);
8. salvage of elements/members of bridge for incorporation into a new structure or for future conservation work or displays;
9. full recording and documentation of structure if it is to be demolished.

Where the demolition of a structure cannot be avoided, there are two recommendations:

- a) “salvage of elements/members of bridge for incorporation into new structure or for future conservation work or display; and

- b) Full recording and documentation of structure prior to demolition” (Cuming 1984: 243).

Table 3 presents an evaluation of the potential impacts of the above alternatives on the cultural heritage resources and identified heritage attributes.

1. Mitigation options 1 – 3 are the preferred conservation options, whereby the bridge is retained in its original location. Option 1 is the preferred option of the three.
2. Mitigation options 4 – 6 retain the bridge but with sympathetic modifications, or, a new bridge with sympathetic build nearby. The heritage attributes addressed Section 6.5 should be retained wherever possible, or where necessary, have sympathetic modifications.
3. Relocation of the bridge if chosen as a preferred option should be for continued use in a close location or for adaptive reuse.
4. If replacement/removal is considered, alternatives 8 and 9, the following needs consideration:
 - a) “salvage of elements/members of bridge for incorporation into new structure or for future conservation work or display; and
 - b) Full recording and documentation of structure prior to demolition” (Cuming 1984: 243).

In addition to the options presented above, the following recommendations/mitigation measures should be considered for the work plan involving the Riversdale Bridge:

1. The final cultural heritage evaluation and cultural heritage impact assessment report should be filed with the County of Bruce and the Ministry of Tourism, Culture and Sport for review.
2. The Riversdale Bridge may be considered for designation under the Ontario Heritage Act (Part IV), and added to the County of Bruce’s Municipal Heritage List.
3. If preservation of the bridge is found to be unsustainable due to a) safety issues b) rehabilitation costs too extensive c) rehabilitation too extensive to warrant preservation; etc.; the County of Bruce may consider retaining heritage attributes of the bridge and use for the construction of a new bridge.
4. Scenic views from the bridge could be maintained, but as a safeguard, the railing work on the bridge would require sympathetic upgrading that will retain the character of the bridge.
5. If replacement of the bridge is the preferred County option, the demolition and new build should consider minimizing impacts to the landscape setting, and retaining the visual scenic character of the area.
6. As a commemorative action, a plaque may be considered.

TABLE 3: EVALUATION OF THE POTENTIAL IMPACTS OF BRIDGE IMPROVEMENT ALTERNATIVES ON THE CULTURAL HERITAGE RESOURCE AND IDENTIFIED HERITAGE ATTRIBUTES

| BRIDGE ALTERNATIVES (RIVERSDALE BRIDGE) | | DESIGN OR PHYSICAL VALUE | HISTORICAL OR ASSOCIATIVE VALUE | CONTEXTUAL VALUE | MITIGATION OPTIONS |
|--|---|--|--|---|-----------------------|
| | | Representative of a single span, 8-panel, Pratt Rivet-Connected through Truss Bridge. One of five such bridges in the County, but the only single span-8 panel bridge. Attributes Identified include: i. Cast-in-place concrete abutments. ii. Steel, single span with 8-panel design. iii. Rivet-connected skeletal framework, including diagonal steel members and horizontal bracing. iv. Timber deck beams. | 1. Built in 1905 by a local company, Hunter Bridge and Boiler of Kincardine. 2. The bridge demonstrates the work or ideas of a local builder (or designer/engineer), Alexander Hunter who was born in 1851 in Brant County. He is considered significant to the community. 3. The bridge was an important part of local transportation routes. | The bridge contributes to the landscape character of the area and is visually linked to the surrounding countryside and town. It is historically linked to the Village of Riversdale emphasizing its former function to serve as a conduit across the Teeswater River. | |
| 1 | Retain existing bridge with no major modifications. | No Impact | No Impact | No impact | A B |
| 2 | Retention of existing bridge, restoration of missing or deteriorated elements where physical or documentary evidence (i.e. photographs or drawings) can be used for their design. | No Impact | No Impact | No Impact | A B C D |
| 3 | Retention of existing bridge with sympathetic modifications. | No Impact Alterations would be sympathetic to the heritage attributes identified. | No Impact | No Impact | A B C D |
| 4 | Retention of existing bridge with sympathetically designed new bridge in proximity to existing location. | No Impact | No Impact | Yes <ul style="list-style-type: none">New bridge would alter the views to and from the bridge, resulting in significant impacts to the landscape character of the area.A new bridge in proximity to the existing bridge would alter the use, immediate setting, and context of the bridge site.Soil disturbance would be expected through the construction of a new bridge in proximity to the existing heritage resource. | A B C E |
| 5 | Retention of existing bridge (no vehicle use) adapted for pedestrian and bicycle conduits, scenic viewing, etc. | Yes May require the installment of new safety features. Impacts to the design value could be minimized by providing consideration to sympathetically designed safety features. | No Impact | Yes <ul style="list-style-type: none">Would require rerouting of local through traffic to other bridge crossings along the Teeswater River.Use of the bridge for pedestrian walkways, cycle paths, scenic viewing etc. would result in a change from the original use of the structure. rerouting of local through traffic | A B F |
| 6 | Retention of bridge as heritage monument for viewing purposes only. | No Impact | No Impact | Yes <ul style="list-style-type: none">Use of the bridge for viewing purposes only would result in the alteration of the current and historical use of the structure.Would require rerouting of local through traffic to the nearby bridge crossing to the south. | A B C |
| 7 | Relocation of bridge for adaptive re-use in an appropriate new site. | Yes Impacts and alterations to the heritage attributes and features are expected through relocation of any, or part of any, heritage attribute or feature. | Yes <ul style="list-style-type: none">Relocation of this cultural heritage resource will isolate it from its original context and its relationship to the community.The river crossing at this location would no longer exist | Yes <ul style="list-style-type: none">Relocation of this cultural heritage resource will isolate it from its original context and its relationship to the community.If bridge removal, without replacement, is considered the river crossing at this location would no longer exist.Soil disturbance is expected through the process of removing the bridge from its current location. | A B C D F |

TABLE 3: EVALUATION OF THE POTENTIAL IMPACTS OF BRIDGE IMPROVEMENT ALTERNATIVES ON THE CULTURAL HERITAGE RESOURCE AND IDENTIFIED HERITAGE ATTRIBUTES

| BRIDGE ALTERNATIVES (RIVERSDALE BRIDGE) | | DESIGN OR PHYSICAL VALUE | HISTORICAL OR ASSOCIATIVE VALUE | CONTEXTUAL VALUE | MITIGATION OPTIONS |
|--|--|--|--|---|--------------------|
| | | Representative of a single span, 8-panel, Pratt Rivet-Connected through Truss Bridge. One of five such bridges in the County, but the only single span-8 panel bridge. Attributes Identified include: i. Cast-in-place concrete abutments. ii. Steel, single span with 8-panel design. iii. Rivet-connected skeletal framework, including diagonal steel members and horizontal bracing. iv. Timber deck beams. | 1. Built in 1905 by a local company, Hunter Bridge and Boiler of Kincardine. 2. The bridge demonstrates the work or ideas of a local builder (or designer/engineer), Alexander Hunter who was born in 1851 in Brant County. He is considered significant to the community. 3. The bridge was an important part of local transportation routes. | The bridge contributes to the landscape character of the area and is visually linked to the surrounding countryside and town. It is historically linked to the Village of Riversdale emphasizing its former function to serve as a conduit across the Teeswater River. | |
| 8 | Replacement/removal of existing bridge with salvage of elements for use into a new structure or future conservation work/displays. | Yes Alterations to the cultural heritage attributes and features are expected through removal and/or the re-location of any, or part of any, heritage attribute or feature. | Yes Alterations to the resource are expected through replacement or removal which would result in negative impacts to its historical value. | Yes • Replacement or removal of this cultural heritage resource would alter the views to and from the bridge, resulting in significant impacts to the landscape character of the area. • Soil disturbance is expected through replacement or removal of the existing structure. | B C G |
| 9 | Replacement/removal of bridge with full recording and documentation. | Yes Alterations to the cultural heritage attributes and features are expected through replacement or removal. | Yes Alterations to the resource are expected through replacement or removal which would result in negative impacts to its historical value. | Yes • Replacement or removal of this cultural heritage resource would alter the views to and from the bridge, resulting in significant impacts to the landscape character of the area. • Soil disturbance is expected through replacement of removal of the existing structure. | B C G |

Notes: Screening for Potential Impacts completed in consideration of the criteria presented in the MTCS document entitled ‘Screening for Impacts to Built Heritage and Cultural Heritage Landscapes’ (November 2010)

Screening for Potential Impacts as per MTCS document entitled ‘Screening for Impacts to Built Heritage and Cultural Heritage Landscapes’ (November 2010)

- i. **Destruction, removal or relocation** of any, or part of any, heritage attribute or feature.
- ii. **Alteration** (which means a change in any manner and includes restoration, renovation, repair or disturbance).
- iii. **Shadows** created that alter the appearance of a heritage attribute or change the exposure or visibility of a natural feature or plantings, such as a garden.
- iv. **Isolation** of a heritage attribute from its surrounding environment, context or a significant relationship.
- v. **Direct or indirect obstruction** of significant views or vistas from, within, or to a built or natural heritage feature.
- vi. **A change in land** use such as rezoning a battle field from open space to residential use, allowing new development o site alteration to fill in the formerly open spaces.
- vii. **Soil Disturbance** such as a change in grade, or an alteration of the drainage pattern, or excavation, etc.

Mitigation Alternatives

- A. Maintain existing bridge.
- B. Signage (plaque, monument)
- C. Architectural drawings (where none available, or where major changes to structure have been made)
- D. Sympathetic replacement/restoration of missing or damaged part.
- E. Build sympathetic new bridge nearby.
- F. Sympathetic modification to bridge for adaptive reuse (pedestrian/bicycle, etc.)
- G. Salvage elements for new structure, conservation/displays (latter could include heritage parks, museums, etc.)

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IMAGES

Image 1: Marking on Horizontal Member (Lanarkshire Steel Co. Scotland)



Image 2: Approach from East End facing Westerly



Image 3: Approach from West End facing Easterly



Image 4: Approach from West End facing Easterly



Image 5: Bridge facing SW



Image 6: Wooden Decking



Image 7: Wooden Deck facing west



Image 10: Abutment on south side facing SE

Image 8: Abutment NE End looking down



Image 11: End Post and Abutment SW corner facing down

Image 9: Abutment SE End looking down



Image 12: Abutment East side facing down and bottom chord



Image 14: Abutment face south side facing E and bottom chord



Image 13: Abutment Face, North side, concrete deterioration



Image 15: Railing Repair north side facing NW



Image 16: Railing Break south side

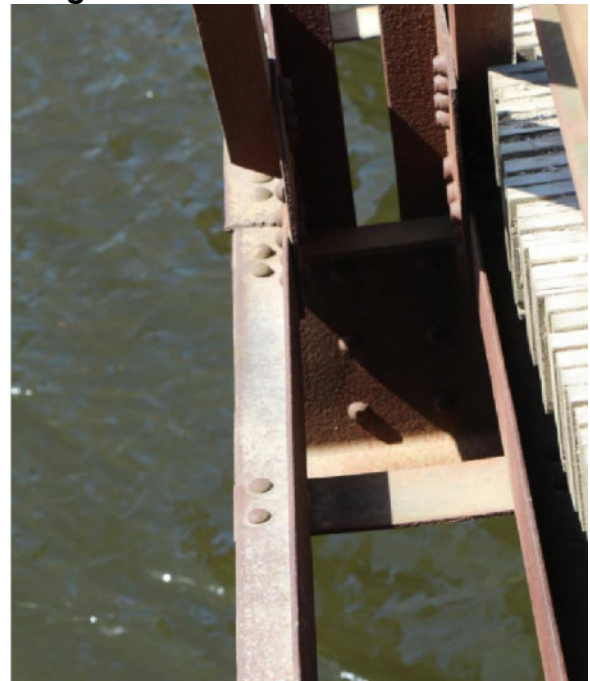


Image 17: Repair Work on Upper Framework, East End



Image 18: Riveted Connection Showing Inclined End Post, Top Chord, Vertical Post

Image 19: Lower Chord



**Image 20: Upper Chord West End
with Portal Bracing**



Image 21: Rivet Construction



**Image 22: View Shed from Bridge
facing South**



**Image 23: View Shed from Bridge
facing North**



Image 24: Deck



Image 25: Wing Back Abutments



Image 26: Modifications



APPENDICES

Appendix A: Riversdale Bridge MEA Heritage Checklist Municipal Heritage Bridges

Cultural, Heritage and Archaeological

Resources Assessment Checklist

Revised April 11, 2014

This checklist was prepared in March 2013 by the Municipal Engineers Association to assist with determining the requirements to comply with the Municipal Class Environmental Assessment. View all four parts of the module on Structures Over 40 Years at www.municipalclassea.ca to assist with completing the checklist.

Project Name: Riversdale Bridge

Location: Riversdale, Ontario

Municipality: Municipality of Brockton, Bruce County

Project Engineer:

Checklist completed by: S. Janusas

Date: March 3, 2018

NOTE: Complete all sections of Checklist. Both Cultural Heritage and Archaeological Sections must be satisfied before proceeding.

Part A – Municipal Class EA Activity Selection

| Description | Yes | No |
|---|--|--|
| Will the proposed project involve or result in construction of new water crossings? This includes ferry docks. | <input type="checkbox"/> Schedule B or C | <input checked="" type="checkbox"/> Next |
| Will the proposed project involve or result in construction of new grade separation? | <input type="checkbox"/> Schedule B or C | <input checked="" type="checkbox"/> Next |
| Will the proposed project involve or result in construction of new underpasses or overpasses for pedestrian recreational or agricultural use? | <input type="checkbox"/> Schedule B or C | <input checked="" type="checkbox"/> Next |
| Will the proposed project involve or result in construction of new interchanges between any two roadways, including a grade separation and ramps to connect the two roadways? | <input type="checkbox"/> Schedule B or C | <input checked="" type="checkbox"/> Next |

| | | |
|---|--|--|
| Will the proposed project involve or result in reconstruction of a water crossing where the structure is less than 40 years old and the reconstructed facility will be for the same purpose, use, capacity and at the same location? (Capacity refers to either hydraulic or road capacity). This includes ferry docks. | <input type="checkbox"/> Schedule A+ | <input checked="" type="checkbox"/> Next |
| Will the proposed project involve or result in reconstruction of a water crossing, where the reconstructed facility will not be for the same purpose, use, capacity or at the same location? (Capacity refers to either hydraulic or road capacity). This includes ferry docks. | <input type="checkbox"/> Schedule B or C | <input checked="" type="checkbox"/> Next |
| Will the proposed project involve or result in reconstruction or alteration of a structure or the grading adjacent to it when the structure is over 40 years old where the proposed work will alter the basic structural system, overall configuration or appearance of the structure? | <input checked="" type="checkbox"/> Next | <input type="checkbox"/> Assess Archaeological Resources |

Part B – Cultural Heritage Assessment

| Description | Yes | | No | |
|---|---|------|-------------------------------------|----------------------------|
| Does the proposed project involve a bridge construction in or after 1956? | <input type="checkbox"/> Next | | <input checked="" type="checkbox"/> | Prepare CHER Undertake HIA |
| Does the project involve one of these four bridge types? | <input type="checkbox"/> Rigid Frame | Next | <input checked="" type="checkbox"/> | Prepare CHER Undertake HIA |
| | <input type="checkbox"/> Precast with Concrete Deck | Next | | |
| | <input type="checkbox"/> Culvert or Simple Span | Next | | |
| | <input type="checkbox"/> Steel Beam/Concrete Deck | Next | | |

| | | | |
|---|--------------------------|-------------------------------|--|
| Does the bridge or study area contain a parcel of land that is the subject of a covenant or agreement between the owner of the property and a conservation body or level of government? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is listed on a register or inventory of heritage properties maintained by the municipality? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is designated under Part IV of the Ontario Heritage Act? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is subject to a notice of intention to designate issued by a municipality? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is located within a designated Heritage Conservation District? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is subject to a Heritage Conservation District study area by-law? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is included in the Ministry of Tourism, Culture and Sport's list of provincial heritage properties? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is part of a National Historic Site? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is part of a United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Site? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is designated under the Heritage Railway Station Protection Act? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |
| Does the bridge or study area contain a parcel of land that is identified as a Federal Heritage Building by the Federal Heritage Building Review Office (FHBRO)? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> Next |

| | | | | |
|---|-------------------------------------|-------------------------------|-------------------------------------|---------------------------------|
| Does the bridge or study area contain a parcel of land that is the subject of a municipal, provincial or federal commemorative or interpretive plaque that speaks to the Historical significance of the bridge? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> | Next |
| Does the bridge or study area contain a parcel of land that is in a Canadian Heritage River watershed? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> | Next |
| Will the project impact any structures or sites (not bridges) that are over forty years old, or are important to defining the character of the area or that are considered a landmark in the local community? | <input checked="" type="checkbox"/> | Prepare CHER Undertake HIA | <input type="checkbox"/> | Next |
| Is the bridge or study area adjacent to a known burial site and/or cemetery? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> | Next |
| Is the bridge considered a landmark or have a special association with a community, person or historical event in the local community? | <input checked="" type="checkbox"/> | Prepare CHER Undertake HIA | <input type="checkbox"/> | Next |
| Does the bridge or study area contain or is it part of a cultural heritage landscape? | <input type="checkbox"/> | Prepare CHER Undertake HIA | <input checked="" type="checkbox"/> | Assess Archaeological Resources |

Part C – Heritage Assessment

| Description | Yes | | No | |
|---|-------------------------------------|--|--------------------------|-----------------------------------|
| Does the Cultural Heritage Evaluation Report identify any Heritage Features on the project? | <input checked="" type="checkbox"/> | Undertake HIA | <input type="checkbox"/> | Part D - Archaeological Resources |
| Does the Heritage Impact Assessment determine that the proposed project will impact any of the Heritage Features that have been identified? | <input type="checkbox"/> | Schedule B or C depends on selected bridge alternative | <input type="checkbox"/> | Part D - Archaeological Resources |

Part D – Archaeological Resources Assessment


| Description | Yes | | No | |
|--|-------------------------------------|------|--------------------------|----------------------|
| Will any activity, related to the project, result in land impacts/significant ground disturbances? | <input checked="" type="checkbox"/> | Next | <input type="checkbox"/> | Schedule A - proceed |

| | |
|---|--|
| <p>Have all areas, to be impacted by ground disturbing activities, been subjected to recent extensive and intensive disturbances and to depths greater than the depths of the proposed activities?</p> | <div> <input type="checkbox"/> Schedule A - proceed <div> <input checked="" type="checkbox"/> Next </div> </div> |
| <p>Has an archaeological assessment previously been carried out that includes all of the areas to be impacted by this project?</p> <p>Does the report on that previous archaeological assessment recommend that no further archaeological assessment is required within the limits of the project for which that assessment was undertaken, and has a letter been issued by the Ministry of Tourism, Culture and Sport stating that the report has been entered into the Ontario Public Register of Archaeological Reports?</p> | <div> <div> <input checked="" type="checkbox"/> Next </div> <div> <input type="checkbox"/> Archaeological Assessment </div> </div> <div> <div> <input checked="" type="checkbox"/> Schedule A - proceed </div> <div> <input type="checkbox"/> Obtain satisfaction letter - proceed </div> </div> |

**** Include Documentation Summary in Project File ****

Note:

Appendix B: Riverside Bridge Survey Form

| | | |
|---|--|-----------------------------------|
| BRIDGE NAME: Riversdale Bridge | Recorder: Scarlett Janusas Archaeology Inc. | Ref. No. 0002/MTO 2-262 |
| ROAD: Bridge Road/Sideroad 20 | Map: | Date: March 3, 2018 |
| Lot: 30,31 Con: 1, NDR |  | |
| Municipality: Municipality of Brockton | | |
| County / R.M.: Bruce | | |
| Map Ref: | | |
| Military Grid Ref: 17T 473056.02E, 4882303.66N | | |
| Air Photo Ref: | | |
| Description: Bridge is located 480 m north of Hwy 9, ne of village of Riversdale, on Bridge Road. | | |
| BRIDGE ENVIRONMENT & USE S | | |
| Water/Road/Rail/Other Crossing: Bridge extends Bridge Street/SR20 across Teeswater River | | |
| Surrounding Land-Uses & Landscape: Bridge is located 480 m north of Highway 9, northeast of village of Riversdale, on Bridge Road, posted 50 km/hour. The Teeswater River is crossed by the bridge. Surrounding area is rural agriculture in nature and undeveloped river bottom and wetlands. | | |
| Bridge Uses: Vehicular Traffic | | |
| DESIGN | | |
| Materials: Steel and concrete | | |
| Construction: Metal, 8 panel rivet-connected Pratt through truss | | |
| Decorative Features: none | | |
| Landscape Quality: The structure is not noticeable from Highway 9. It supports the rural landscape. | | |
| State of Preservation: poor to moderate | | |
| Other Comments: There is no skew on the bridge. The design intent of the bridge is intact. | | |

| | |
|---|---------------------------------------|
| DIMENSIONS | |
| Carriageway Width: | Longest Span: |
| No. of Lanes: two | Shortest Span: |
| Sidewalks: none | Overall Structure Length: 125' |
| Capacity: unknown | Overall Structure Width: |
| No. of Spans: one | Clearance: unknown |
| HISTORY | |
| Date Built: ca. 1905 | |
| Engineer/Designer: unknown Hunter Bridge & Boiler Company | |
| Construction Firm: Hunter Bridge & Boiler Company | |
| Drawings/ Specifications: none found to date | |
| Photos: no historic photographs located | |
| <p>Historical Association: The bridge is historically associated with the County of Bruce's intent to improve two bridges in the Riversdale area ca. 1905. The bridge is historically associated with the Hunter Bridge & Boiler Company, a well known bridge building firm.</p> | |
| <p>Previous Bridges: A bridge appears to have spanned the river in 1856, and there may have been more from 1856 to 1898, when Cromar's bridge was established.</p> | |
| Other Comments: | |
| PROPERTY RIGHTS & RESPONSIBILITIES | |
| Owner: Municipality of Brockton | Maintenance: Municipality of Brockton |
| PLANNED UNDERTAKING | |
| The County of Bruce will be undertaking a Municipal Class EA regarding the removal of the Riversdale Bridge. | |
| GENERAL COMMENTS | |
| | |

Appendix C: Cemetery Search



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[Data last updated on Jul 21, 2017 at 08:45 hours]

Search Results

Your search result on County/District: **BRUCE, COUNTY OF**, Municipality: **BROCKTON, MUNICIPALITY OF (TWP)**, Lot: **30**, Concession: **1 NDR**, requested on Jul 21, 2017 returns **0** record. Please verify your search criteria or [click here for search tips](#).

[\[MAIN SEARCH SCREEN\]](#) | [\[NEW SEARCH\]](#)

The Licensing, Inspections and Investigations Branch provides this information as a public service. All search results are current as of the date of the search. As this is an unofficial search, if you require an official search or clarification, or to report any errors or discrepancy, contact the Licensing, Inspections and Investigations Branch at:



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[Data last updated on Jul 21, 2017 at 08:45 hours]

Search Results

Your search result on County/District: **BRUCE, COUNTY OF**, Municipality: **BROCKTON, MUNICIPALITY OF (TWP)**, Lot: **31**, Concession: **1 NDR**, requested on Jul 21, 2017 returns **0** record. Please verify your search criteria or [click here for search tips](#).

[\[MAIN SEARCH SCREEN\]](#) | [\[NEW SEARCH\]](#)

The Licensing, Inspections and Investigations Branch provides this information as a public service. All search results are current as of the date of the search. As this is an unofficial search, if you require an official search or clarification, or to report any errors or discrepancy, contact the Licensing, Inspections and Investigations Branch at:

Appendix D: Correspondence

SCARLETT JANUSAS ARCHAEOLOGY INC.
269 Cameron Lake Road, Tobermory, Ontario N0H 2R0
Phone 519-596-8243, cell 519-374-1119
jscarlett@amtelecom.net
www.actionarchaeology.ca



July 19, 2017

Mr. Thomas Wicks, Heritage Planner
Ontario Heritage Trust
10 Adelaide Street West
Toronto, Ontario
M5C 1J3

Via email: Thomas.Wicks@heritagetrust.on.ca

To Whom It May Concern:

**RE: Cultural Heritage Evaluation
Riversdale Bridge, between Lots 30 and 31, Concession 1 NDR, Municipality
of Brockton, Bruce County**

I have been retained by the County of Bruce to conduct a cultural heritage evaluation of the proposed development for the Riversdale Bridge located on Bridge Street, Village of Riversdale, Municipality of Brockton, Bruce County.

As part of our due diligence, we are requesting if the Ontario Heritage Trust has any heritage concerns regarding this area – and if so, could you please elaborate on what these specific concerns relate to in general and specifically.
I attach a map of the study area.

Many thanks.

Sincerely

Scarlett E. Janusas, B.A., M.A., CAHP, RPA
President, SJAI
Member, CNEHA, SHA, OMHC, CAHP

Response from Ontario Heritage Trust



Tue 7/25/2017 11:27 AM

Thomas Wicks <Thomas.Wicks@heritagetrust.on.ca>

RE: OHT input on another project

To: Scarlett Janusas

Hi Scarlett,

Thank you for the letter dated July 19, 2017 requesting information from the Trust regarding potential heritage concerns regarding the proposed development of a bridge on Bridge Street in Riversdale, Bruce County.

The Ontario Heritage Trust does not own any properties within or adjacent to the subject property area, nor do we hold an easement agreement on any properties within or adjacent to the subject site. As we do not have any legal interests in this area we will not be providing comments regarding the site's cultural heritage.

Thank you for consulting with the Trust regarding this matter.

Regards
Thomas

SCARLETT JANUSAS ARCHAEOLOGY INC.
269 Cameron Lake Road, Tobermory, Ontario N0H 2R0
Phone 519-596-8243, cell 519-374-1119
jscarlett@amtelecom.net
www.actionarchaeology.ca



July 19, 2017

Ms. Kelly Coulter
Chief Administrative Officer
Bruce County

Via email: KCoulter@brucecounty.on.ca

Dear Ms. Coulter:

RE: Cultural Heritage Evaluation

**Riversdale Bridge, between Lots 30 and 31, Concession 1 NDR, Village of
Riversdale, Municipality of Brockton, Bruce County**

I have been retained by the County of Bruce to conduct a cultural heritage evaluation of the proposed development for the Riversdale Bridge located on Bridge Street, village of Riversdale, Municipality of Brockton, Bruce County.

As part of our due diligence, we are requesting if the Ontario Heritage Trust has any heritage concerns regarding this area – and if so, could you please elaborate on what these specific concerns relate to in general and specifically.
I attach a map of the study area.

Many thanks.

Sincerely

Scarlett E. Janusas, B.A., M.A., CAHP
President, SJAI
Member, APA, CNEHA, SHA, OMHC, CAHP

No Response from County of Bruce as of August 11, 2017

Assuming no concerns

Email correspondence to Municipality and Ministry of Transportation

-----Original Message-----

From: Hayes, Chris (MTO) [mailto:Chris.Hayes2@ontario.ca]

Sent: Wednesday, February 28, 2018 11:04 AM

To: Scarlett Janusas <jscarlett@amtelecom.net>

Subject: RE: additional bridges

No problem.

Just a little disappointed that we didn't find any drawings.

Let us know if you need us to look up any drawings in the future.

Regards,

Chris Hayes
Ministry of Transportation
Structural Technician
Chris.Hayes2@ontario.ca
[519-873-4343](tel:519-873-4343)

-----Original Message-----

From: Scarlett Janusas [mailto:jscarlett@amtelecom.net]

Sent: February 28, 2018 11:01 AM

To: Hayes, Chris (MTO)

Subject: RE: additional bridges

Really appreciate everyone having a look. Thank you Chris.

Regards
Scarlett

-----Original Message-----

From: Hayes, Chris (MTO) [mailto:Chris.Hayes2@ontario.ca]
Sent: Wednesday, February 28, 2018 11:00 AM
To: Scarlett Janusas <jscarlett@amtelecom.net>
Subject: RE: additional bridges

Scarlett,

Sorry, but Bridge Office couldn't find any drawings for either 2-262 or 2-413.

And sorry for the wait.

Regards,

Chris Hayes
Ministry of Transportation
Structural Technician
Chris.Hayes2@ontario.ca
[519-873-4343](tel:519-873-4343)

-----Original Message-----

From: Scarlett Janusas [mailto:jscarlett@amtelecom.net]
Sent: February 27, 2018 3:40 PM
To: Hayes, Chris (MTO)
Cc: Drea Nelson - GM BluePlan
Subject: RE: additional bridges

Thank you.

-----Original Message-----

From: Hayes, Chris (MTO) [mailto:Chris.Hayes2@ontario.ca]
Sent: Tuesday, February 27, 2018 3:33 PM
To: Scarlett Janusas <jscarlett@amtelecom.net>
Subject: RE: additional bridges

Scarlett,

Sorry, I haven't heard back from bridge office yet. Again I'll let you know if they send me anything.

Regards,

Chris Hayes
 Ministry of Transportation
 Structural Technician
Chris.Hayes2@ontario.ca
[519-873-4343](tel:519-873-4343)

-----Original Message-----

From: Scarlett Janusas [mailto:jscarlett@amtelecom.net]
 Sent: February 25, 2018 1:42 PM
 To: Hayes, Chris (MTO)
 Subject: RE: additional bridges

Hi Chris - any updates on these two bridges? Much appreciated.

Regards
 Scarlett

-----Original Message-----

From: Hayes, Chris (MTO) [mailto:Chris.Hayes2@ontario.ca]
 Sent: Thursday, February 15, 2018 3:50 PM
 To: Scarlett Janusas <jscarlett@amtelecom.net>
 Subject: RE: additional bridges

Scarlett,

I found out the site numbers for the Bruce County structures, 2-262 in Riversdale and 2-413 in Paisley. I had a look around our off and again found nothing. So, I sent the request off to Bridge Office, I would hope to hear back from them within a weeks time.

I'll let you know what they find either way.

Regards,

Chris Hayes
 Ministry of Transportation
 Structural Technician
Chris.Hayes2@ontario.ca
[519-873-4343](tel:519-873-4343)

Original Message

From: Scarlett Janusas [mailto:jscarlett@amtelecom.net]
 Sent: February 13, 2018 2:15 PM
 To: Hayes, Chris (MTO); Haalstra, Martin (MTO)
 Cc: Drea Nelson - GM BluePlan
 Subject: additional bridges
 Importance: High

Hi again - I just had contact with the County of Bruce Roads/Transportation Director and he said that MTO used to have a municipal bridge office (now closed). They have no files at their end - but thought maybe you could track them down. I'm attaching the maps for both. If it is possible, could you please provide all information (plans, repairs, reports, pictures) for these two bridges.

Very much appreciated,
 Regards
 Scarlett

Scarlett Janusas, BA, MA, CAHP, RPA
 Member CAHP, CNEHA, OMHC, SHA
 President, Scarlett Janusas Archaeology Inc.

Good afternoon,

I believe the bridges are both in Brockton and we do not have files on the Riversdale Bridge yet might have something on the northerly bridge that was part of a Master Plan study done in about 2005. I recall Brockton, John Strader, overseeing a deck repair on the northerly bridge. I understand that MTO used to be the custodians of bridge files yet I believe their municipal bridge office has closed and they sent out the information (maybe copies?). We shall look into the North Bridge information we have and email...hopefully this week.

Many thanks,
 Brian

Brian Knox
 Engineer
 Transportation & Environmental Services
 Corporation of the County of Bruce

519-881-2400 ext 263
www.brucecounty.on.ca

Sent: Tuesday, February 13, 2018 9:13 AM
 To: Brian Knox <bknox@brucecounty.on.ca>
 Subject: Bridges

Good Morning Brian - I'm doing some revisions to two bridge reports for the County of Bruce, and was hoping that you (the County) would have a file for both bridges which would provide information on maintenance, upgrades, photos, blueprints, etc. The bridges are: Bridge 0002, or the Riversdale Bridge and Bridge 11, Brockton Bridge.

Attaching location maps for same.

If you have such a file for each, I can arrange to come and copy the portions of the file that apply to the CHER.

Thanks -hope you are enjoying the winter so far.

Scarlett

Scarlett Janusas, BA, MA, CAHP, RPA
 Member CAHP, CNEHA, OMHC, SHA
 President, Scarlett Janusas Archaeology Inc.

Appendix E: Heritage Rivers

From the website, <http://chrs.ca/the-rivers/>, the following rivers are Canadian Heritage Rivers in Ontario. The Teeswater River is not on the list. This list was accessed on July 19th, 2017.



Ontario

- ~ Bloodvein River
- ~ Boundary Waters/Voyageur Waterway
- ~ Detroit River
- ~ French River
- ~ Grand River
- ~ Humber River
- ~ Mattawa River
- ~ Missinaibi River
- ~ Ottawa River
- ~ Rideau Waterway
- ~ St. Mary's River
- ~ Thames River

Appendix F: National Historic Sites

From the website, <http://www.soto.on.ca/national-historic-sites-of-southern-ontario/>, the following are National Historic Sites in Southern Ontario. The bridge located on Concession Road 20, Municipality of Brockton does not appear on the list. The list was accessed July 19th, 2017.

National Historic Sites

- ▶ Bell Homestead
- ▶ Fort George
- ▶ Fort Malden
- ▶ HMCS Haida
- ▶ Navy Island
- ▶ Point Clark Lighthouse
- ▶ Queenston Heights
- ▶ Southwold Earthworks
- ▶ Trent-Severn Waterway
- ▶ Woodside

Appendix G: Federal Heritage Buildings

A search was made for Federal heritage buildings using the key words “Bruce County”. Four places were noted, but none of them pertain to the bridge or its environs. The website, <http://www.pc.gc.ca/apps/dfhd/result>, was accessed July 19th, 2017.

Parks Canada
Directory of Federal Heritage Designations

Home
Contact Us

Home > Directory of Federal Heritage Designations > Search the Register > Search Results

Directory of Federal Heritage Designations

Search the Directory
About the Directory
Directory Statistics
Recent Designations
Historic Sites and Monuments Board of Canada
Federal Heritage Buildings Review Office
Historic Railway Stations Protection Act
Heritage Lighthouses Program

Found 4 Results

Results Per Page:
10 25 50 100

Tower (FHB)

Griffith Island, Ontario
Home > Directory of Federal Heritage Designations > Federal Heritage Buildings

Tower (FHB)

Fathom Five National Marine Park of Canada, Ontario
Home > Directory of Federal Heritage Designations > Federal Heritage Buildings

page_fhbros_eng.aspx?id=4463 (FHB)

Chantry Island, Ontario
Home > Directory of Federal Heritage Designations > Federal Heritage Buildings

page_fhbros_eng.aspx?id=4464 (FHB)

Christian Island, Ontario
Home > Directory of Federal Heritage Designations > Federal Heritage Buildings

An additional search was made at the Canadian Register for Historic Places on March 4, 2018. There were no bridges identified in or near the study area.

Canada's Historic Places
A Federal, Provincial and Territorial Collaboration

THE REGISTERHERITAGE CONSERVATIONTHE PARTNERSINTERACTMORECONTACT US

CANADIAN REGISTER SEARCH RESULTS

Map

Enter a keyword or search term(s)

Province / Territory

Location (city, town, township)

Jurisdiction

Postal code (first three characters)

Purpose Group

Purpose

Search

Clear Fields

Total Results: 12, Page: 1 of 2

Results per page: 10

MAP

Cambridge Main Street Bridge
0, Main Street, City of Cambridge, Ontario
The Cambridge Main Street Bridge spans the Grand River between Water and Melville Streets. In the former City of Galt, now the City of Cambridge. The bridge is a multiple-span...

MAP

Gow's Bridge
McCrae Boulevard, Guelph, Ontario
Gow's Bridge spans the Speed River on the west side of Royal City Park. This stone bridge continues to serve both vehicular and pedestrian traffic. Gow's Bridge has been...

MAP

Main Street Bridge
0, Main Street East, Welland, Ontario
Towering over the Welland Canal and constructed in 1927 is the City of Welland's most recognizable landmark, the Main Street Bridge. The bridge spans the Welland Canal at East...

MAP

Freeport Bridge
0, King Street, City of Kitchener, Ontario
The Freeport Bridge spans the Grand River on King Street East between Riverbank Drive and Stonegate Drive in the City of Kitchener. The property consists of a multiple-span...

MAP

Norwich Street Bridge
0, Norwich Street, City of Guelph, Ontario
The Norwich Street Bridge, built in 1882, crosses the Speed River to connect two sections of Norwich Street, in the Goldie Mill neighbourhood of Guelph. The single-span...

MAP

Otter Creek Bridge
0, Middletown Line, Township of Norwich, Ontario
The Otter Creek Bridge, spans the Big Otter Creek and is located on Middletown Line between Cornell and New Roads, in the Township of Norwich. The steel pony truss bridge was...

MAP

Blackfriars Bridge
0, Blackfriars Street, City of London, Ontario
The Blackfriars Bridge, a reinforced wrought-iron bowstring bridge, was constructed in 1875. It spans the North Branch of the Thames River, on Blackfriars Street, in the City of...



West Montrose Covered Bridge

0, Covered Bridge Drive, Township of Woolwich, Ontario

The West Montrose Covered Bridge is a late 19th century covered wooden bridge that spans the Grand River in the rural village of West Montrose. Connecting Hill Street, Covered...



Seneca Bridge

651, Caithness Street E., Haldimand County, Ontario

The Seneca Bridge is a small steel and concrete bridge, crossing the Black Creek on the River Road (Highway 54, between Caledonia and Cayuga), in Haldimand County. Following the...



The Radial Arch

0, Queen Street, Newmarket, Ontario

The Radial Arch, built in 1909, is located on Queen Street between Main Street and Charles Street. Erected to support a wooden trestle bridge spanning the Holland River, it is...



Stone Road Bridge

0, Stone Road, City of Guelph, Ontario

The Stone Road Bridge spans the Eramosa River on Stone Road East, between Victoria Road South and Watson Road South, in the City of Guelph. The single-span concrete bowstring...



Church Street Bridge

0, Church Street North, St. Marys, Town of, Ontario

The Church Street Bridge spans Trout Creek, between Station Street and Queen Street East, in the Town of St. Marys. The two-arch stone bridge was constructed in 1884.

The...



Appendix H: Municipally Designated Sites

The bridge is not included in a list of municipally designated sites in Brockton. The website, <http://www.brockton.ca/en/visit-us/heritage-properties.asp>, was accessed on July 19th, 2017.

Click on the links below to learn more about Brockton's designated heritage properties:

- [St. Thomas Anglican Church – 305 Colborne Street, Walkerton](#)
- [Walkerton Baptist Church – 120 Cayley Street, Walkerton](#)
- [Joseph Walker House – 15 McNab Street, Walkerton](#)
- [Victoria Jubilee Hall – 111 Jackson Street, Walkerton](#)
- [James Rothwell Block – 336 Durham Street East, Walkerton](#)
- [Hartley House Hotel – 7 Jackson Street North, Walkerton](#)
- [John Rowland House – 410 Jackson Street, Walkerton](#)
- [Walkerton Carnegie Library – 249 Durham Street East, Walkerton](#)
- [St. John's Old Lutheran Pioneer Cemetery – 260 Sideroad 30, Brant Township](#)
- [Henry Cargill White House – 12 Concession 10, Cargill](#)

Bridge was not included on the “listed” heritage properties.

Click on the links below to learn more about Brockton's listed heritage pro

- [Walkerton Armoury – 215 Jane Street, Walkerton](#)
 - [Dickison House – 124 Colborne Street, Walkerton](#)
 - [Bobler House – 404 Victoria Street, Walkerton](#)
 - [Shaw-Viewfield House – 951 Old Durham Road, Walkerton](#)
 - [R.E. Truax House – 414 Scott Street, Walkerton](#)
 - [R. Truax House – 411 Scott Street, Walkerton](#)
 - [H.P. O'Connor House – 430 Jackson Street, Walkerton](#)
 - [Mc Connell House – 310 Victoria Street, Walkerton](#)
 - [Pellow's Pharmacy – 228 & 232 Durham Street East, Walkerton](#)
 - [Skelton House – 6 Scott Street, Walkerton](#)
 - [T. Cameron House – 106 Cayley Street, Walkerton](#)
 - [Dr. M. Stalker House – 107 Cayley Street, Walkerton](#)
 - [J. Hargreaves House – 7 Cayley Street, Walkerton](#)
 - [Campbell Grant House – 620 Gibson Street, Walkerton](#)
 - [Hobley House – 108 Cayley Street, Walkerton](#)
 - [Binder Twine Factory – 106 Colborne Street N, Walkerton](#)
 - [Hampson Foundry – 10 Yonge Street North, Walkerton](#)
 - [Sacred Heart Parish – 220 Victoria Street](#)
 - [Old Anglican Rectory – 311 Colborne Street, Walkerton](#)
 - [Judge Barrett House \(Wesley\) – 810 Yonge Street, Walkerton](#)
 - [Dr. Mullen House – 415 Gibson Street, Walkerton](#)
 - [Kilmer Livery Stable – 11 Victoria Street South, Walkerton](#)
 - [Brown's Pharmacy – 331 Durham Street East, Walkerton](#)
 - [Walkerton Gaol – 207 & 213 Cayley Street, Walkerton](#)
 - [Bruce County Court Complex 207-215 Cayley Street, Walkerton](#)
-

Appendix I: Partial CV of Scarlett Janusas

SCARLETT JANUSAS ARCHAEOLOGY INC.
269 Cameron Lake Road Tobermory, Ontario N0H 2R0
Phone 519-596-8243 cell 519-374-1119
jscarlett@amtelecom.net
www.actionarchaeology.ca

COMPANY PROFILE

Scarlett Janusas Archaeology Inc. (SJA) is a consulting firm with area representatives in Owen Sound, Kingston, the Greater Toronto Area, Hamilton, London, Peterborough, Niagara-on-the-Lake, and Tobermory, Ontario. We conduct archaeological work **anywhere** in the province of Ontario, on land and underwater. Our experience has taken us to Thunder Bay in the north, Pembroke and Ottawa in the east, Amherstburg in the east; and Niagara on the Lake in the south, and all points in between. Our work has included partnerships and engagement with many First Nation and Métis groups across the province.

Staff and associates include:

- Ms. Scarlett Janusas, President of the company, and an experienced underwater and land based archaeologist, with experience in both prehistoric and historic archaeology, and over 39 years' experience.
- Ms. Susan Bazely, Senior Archaeologist and Education Coordinator, with 33 years' experience;
- Mr. John Grenville, Cultural Heritage Specialist, over 35 years' experience;
- Dr. Thomas Arnold, Senior Archaeologist and surveyor, 37 years' experience
- Mr. James Bandow, Senior Archaeologist, 33 years' experience
- Ms. Chelsea Robert; Field Director/Archaeologist; lab supervisor; 10 years' experience;
- Mr. Pete Demarte, Field Director/Archaeologist, 9 years' experience
- Ms. Gina Martin, historian, land conveyancer and genealogist with over 30 years' experience;
- Mr. Patrick Folkes, a recognized marine and land historian with over 40 years research experience;
- Mr. Douglas Sweiger, a material culture specialist in small arms and military history with over 25 years' experience;
- Mr. David Gilchrist, a marine archaeologist and teaching specialist with over 30 years' experience;
- Dr. Kimberly Monk, marine archaeologist and education expert;
- Mr. Jim Garrington, Shark Marine Technologies for geophysical projects.

Our vast experience allows us to offer our clients a multitude of services including both land and underwater archaeology, and prehistoric and historic archaeology. The company has licensed archaeologists under the requirements of the Ontario Heritage Act and is able to conduct Stage 1 (background research), Stage 2 (preliminary field

assessment), Stage 3 (definitive field assessment) and Stage 4 (complete site mitigation) for all archaeological projects. In addition, we have the resources to offer our clients follow-up services such as development of interpretative displays, hands-on education, and educational course development.

SCARLETT E. JANUSAS

269 Cameron Lake Road, Tobermory, Ontario N0H 2R0 www.actionarchaeology.ca
 Phone 519-596-8243 cell 519-374-1119 jscarlett@amtelecom.net

EDUCATION B.A., Anthropology/Archaeology, University of Western Ontario, London, Ontario
 M.A., Anthropology/Archaeology, Trent University, Peterborough, Ontario
 National Museum of Canada, Ottawa, Ontario
 Basic Museum Management Certificate

University of Waterloo, Waterloo, Ontario
 Courses towards a Certificate in Environmental Assessment
 Submerged Worlds and Marine Archaeology, University of Southampton

AFFILIATIONS ONTARIO MARINE HERITAGE COMMITTEE
 ONTARIO ARCHAEOLOGICAL SOCIETY
 SOCIETY FOR HISTORICAL ARCHAEOLOGY
 ASSOCIATION OF PROFESSIONAL ARCHAEOLOGISTS
 (V.P. 2005-2009) (PRES. 2009-2013) (PAST PRESIDENT 2013-2015)
 COUNCIL FOR NORTHEASTERN HISTORIC ARCHAEOLOGY
 CHAIR OF TOBERMORY HYPERBARIC FACILITY BOARD
 (2017-2019)

Experience:

2013 to date **SCARLETT JANUSAS ARCHAEOLOGY INC.**

President – Responsible for conducting cultural impact assessment and site mitigation and development of cultural resource management plans for clients in Ontario as part of the Ontario Heritage Act, the Planning Act, the Aggregates Act and as part of environmental impact assessment both on land and underwater. Compliance with the Ministry of Labour Regulations for work conducted underwater. Responsible for day to day management of above mentioned firm. Responsible for varied crew sizes, ranging from 1 to 60 persons depending on project needs. Experience includes writing proposals and schedules, administration, co-ordination of projects and crew, data collection and analysis, photography, graphics, report writing and preparation, invoicing, payroll, accounting, and compliance mitigation.

2002 -2013 **SCARLETT JANUSAS ARCHAEOLOGICAL AND HERITAGE
 CONSULTING AND EDUCATION**

President – Responsible for conducting cultural impact assessment and site mitigation and development of cultural resource management plans for clients in Ontario as part of the Ontario Heritage Act, the Planning Act, the Aggregates Act and as part of environmental impact

assessment both on land and underwater. Compliance with the Ministry of Labour Regulations for work conducted underwater. Responsible for day to day management of above mentioned firm. Responsible for varied crew sizes, ranging from 1 to 30 persons depending on project needs. Experience includes writing proposals and schedules, administration, co-ordination of projects and crew, data collection and analysis, photography, graphics, report writing and preparation, invoicing, payroll, accounting, and compliance mitigation.

2009, 2010

THIS LAND ARCHAEOLOGY

FIELD DIRECTOR/ASSOCIATE – STAGE 2, 3 AND 4 PROJECTS IN GREATER TORONTO AREA, RICHMOND HILL, AURORA, BOND HEAD, BRAMPTON, BRANTFORD, INNISFIL, BRADFORD, VAUGHAN, OSHAWA.

1995 to 2002 **MAYER HERITAGE CONSULTANTS**

Consulting Archaeologist – Responsible for conducting cultural impact assessment and site mitigation and development of cultural resource management plans for clients in Ontario as part of the Ontario Heritage Act, the Planning Act, and as part of environmental impact assessment both on land and underwater. Responsible for varied crew sizes, ranging from 1 to 16 persons, depending on project needs. Responsibilities include writing proposals, schedules, co-ordination of projects and crew, data collection and analysis, photography, graphics, and report writing and preparation.

1993 to 1995 **GOLDER ASSOCIATES LIMITED**

Senior Archaeologist – Responsible for eastern Canada, development of an archaeology section, preparation of proposals, field and laboratory work, preparation of reports, marketing and budgeting. Associate in environmental assessment projects.

1993 to 2002 **ONTARIO MARINE HERITAGE COMMITTEE**

Co-Principal in the Submerged Prehistoric Shoreline Study in Georgian Bay in cooperation with the Ontario Marine Heritage Committee, Parks Canada, Fathom Five National Marine Park and the Geological Survey of Canada. The study focused on the geological history of previously exposed watercourses and the archaeological potential of the former exposed areas for archaeological sites dating to the Paleo and Archaic periods of southwestern Ontario. The technical portion of the project includes the use of side scan sonar, GPS, depth sounders, navy submersibles, remote videos, SCUBA, and computers.

1991 to 2001 **ONTARIO MARINE HERITAGE COMMITTEE**

Chairperson – Responsibilities include scheduling, organization of workshops and meetings, administrative duties, chairing meetings and providing archaeological input into proposed and active projects.

1986 to 1993 **REGIONAL MUNICIPALITY OF WATERLOO**

Regional Archaeologist – Responsibilities included 1) the provision of expert advice on archaeological matters to municipalities, developers, planning, engineering and archaeological consultants regarding archaeological potential of the Region, and Planning and Development policy pertaining to heritage resource management; 2) undertaking research and special studies to support Regional decisions on archaeologically related matters; 3) acted as an archaeological consultant for the Region; 4) acted as the liaison between the Province of Ontario and the Municipality; 5) developed policy for the effective management of archaeological resources; 6) acted as an information source for private, business and public sectors on matters of archaeology; 7) initiated and conducted special projects a) the creation of a permanent Archaeology Division

for the Regional Municipality of Waterloo b) researched, developed and published the **first** Archaeological Master Plan in the Province of Ontario c) invited participant for the Federal Environmental Assessment Review Office Environmental Assessment and Heritage National Workshop, Ottawa; d) staff liaison for the Regional Official Policies Plan Heritage Advisory Committee (1991-1993); e) acquired the loan of the prehistoric and historic Lisso collection and conducted analysis of the collection f) organized and supervised the collection and analysis of urban historic archaeological potential data for urban centres in the Regional Municipality of Waterloo g) member of the Regional Official Policies Plan Management Team h) Regional courses in field archaeology i) volunteer program j) designation of an Aboriginal cemetery for remains located during development and k) field school at the Waterloo County Jail for primary grade students.

1984 to 1997 SCARLETT JANUSAS AND ASSOCIATES INC.

President of Archaeological Consulting Firm– Created firm in response to development pressures on archaeological resources. Services provided by the firm included background research studies, archaeological resource assessments, cultural impact studies, interpretative design projects, resource evaluation and interpretation models, extant artifact collection documentation, analysis and interpretation, archaeological excavation and monitoring, cultural resource management, historic research to locate environmental hazards, historic interpretation of properties (genealogy of historic properties). Scarlett Janusas and Associates Inc. was a Canadian heritage and archaeological consulting firm specializing in archaeological resource assessment, cultural impact studies, cultural resource management and interpretative studies for land and underwater heritage resources.

1992 to 1995 MAYER HERITAGE CONSULTANTS INC.

Marine Heritage Associate – Responsibilities included management of all marine heritage projects.

1990 ONTARIO MARINE HERITAGE COMMITTEE

Co-principal for the archaeological documentation of the HMS NEWASH.

1990 ONTARIO HERITAGE FOUNDATION

Principal Conservator – Responsible for the restoration of ceramic class from Inge Va, Perth County, Ontario.

1989 CANADIAN PARKS SERVICE

Volunteer – Mapping of the shipwreck the MINCH in Fathom Five National Marine Park.

1988 SCARLETT JANUSAS AND ASSOCIATES INC.

Principal Investigator – Responsible for the underwater survey of Ste. Marie II, Christian Island and for research for the marine history of the Christian Islands for the Christian Island Archaeological Master Plan.

1987 MAYER, PIHL, POULTON AND ASSOCIATES

Principal Investigator – Responsible for conducting the TransCanada Kirkwell Pipeline Survey.

1987 SCARLETT JANUSAS AND ASSOCIATES INC.

Principal Investigator – Responsible for the preliminary investigations of a scuttled ship located in the excavation of the Dome Stadium.

1986 **MAYER, PIHL, POULTON AND ASSOCIATES**

a) Field Assistant – Responsible for the Union Gas pipeline heritage assessment in Ancaster/Hamilton area, housing development.

b) Field Assistant – excavation of the Pengelly site near Mississauga, a Middle Woodland village.

c) Field Assistant – several housing subdivision heritage resource assessments in the cities of Kitchener and Waterloo.

1986 **EMPRESS OF IRELAND HISTORICAL SOCIETY**

Archaeological Consultant – Providing archaeological advice to the Society.

1986 **ONTARIO MARINE HERITAGE COMMITTEE**

Archaeological Assistant – Responsible for the preliminary mapping and excavation of an unidentified mid-19th century ship located in Lake Erie at a depth of 70’.

1986 **SCARLETT JANUSAS AND ASSOCIATES**

Principal – Responsible for investigation of a proposed dock area at Historic Naval and Military Establishments. Underwater archaeological survey.

1985 **TORONTO HISTORICAL BOARD**

Senior Archaeologist – Developed a study report recommending a City Archaeology Policy and implementation guidelines. Two excavations were also conducted at the MacKenzie House and St. James Cathedral. Impact assessment of Toronto Island historic midden.

1984-1987 **MAYER, PIHL, POULTON AND ASSOCIATES**

Consulting Archaeologist – Conducting impact assessments and site mitigation on such projects as Union Gas Pipeline impact assessment in Ancaster/Hamilton area, subdivision in Niagara Region, excavation of the Pengelly site near Mississauga, subdivision assessment in Kitchener, excavation of 19th century mill (Elmdale Mill) in Ajax, and archaeological assessment along Moira River, Belleville.

1984 **CANADIAN PARKS SERVICE**

a) Archaeologist – Responsible for conducting an archaeological resource evaluation of Point Pelee National Park and the development of the Point Pelee National Park Cultural Resource Management Plan. Also conducted two field campaigns to Central Grenadier Island in St. Lawrence Islands National Park. Acted as co-leader in the presentation of a special seminar at Point Pelee National Park to inform staff of progress of the Archaeological Resource Management Plan and to aid in establishing and interpretation exhibition of the prehistory of man at the Park.

b) Marine Archaeologist (GT-2), Marine Heritage Unit – Red Bay project, Labrador. Responsible for the excavation of a 16th century Spanish Basque whaling ship locating in approximately 40’ of water including mapping and recording. Experience with airlifts, dry suits and hot water suits.

1983 **FATHOM FIVE PROVINCIAL PARK**

Docent – Aided visiting divers in orientation to the Park, its rules and regulations, and provided information of shipwrecks of the area.

1983 to 1986 **ONTARIO UNDERWATER COUNCIL**

Vice-President of Marine Conservation – Responsible for providing initiative for the certifying agencies to include an underwater archaeological component in their teaching programs. Developed a slide show on underwater archaeology. Established the Marine Heritage Trust Fund. Hosted and organized numerous underwater archaeological seminars and workshops including Thunder Bay and Toronto.

1983 MINISTRY OF CITIZENSHIP AND CULTURE

Archaeologist – Assisted in various underwater archaeological projects across the province including Port Abino and Niagara-on-the-Lake.

1983 ONTARIO MARINE HERITAGE COMMITTEE

Consultant – Provided advice on submerged resource survey of waters off the Penetanguishene Naval and Military Establishments.

1983 SAVE ONTARIO SHIPWRECKS

Consultant – Provided advice on the recording and survey of an 18th century wharf at Navy Hall.

1983 ONTARIO HERITAGE FOUNDATION

Originator, Designer, Producer and Promoter – slide and cassette show on underwater archaeology, lecture material for various diving agencies in Ontario on marine conservation. Grant.

1983 ONTARIO UNDERWATER COUNCIL

a) **Program Chairperson** – 3rd Annual Underwater Archaeological Seminar.

b) **Originator and Developer** – Ontario Underwater Council Heritage Trust Fund.

c) **OUN Representative** – Provided input for the National Marine Parks Policy.

1983 to 1991 MAYER, POULTON AND ASSOCIATES

Marine Heritage Associate – Provide advice on all marine projects.

1983 MUSEUM OF INDIAN ARCHAEOLOGY

Assistant Archaeologist – GO TRAIN (Ministry of Transportation and Communication) survey conducted near Oshawa, Ontario.

Field Director – Crawford Lake site, a Middle Woodland village for the Halton Region Conservation Authority. Supervision of a crew of 8 in the excavation and recording of a longhouse and test trenches.

Field Assistant – archaeological resource assessment of the McGrath Site, Middlesex County.

1982 MUSEUM OF INDIAN ARCHAEOLOGY

Assistant Field Director – Willcock site, Byron, Ontario. Responsible for the supervision of the excavation of an undisturbed prehistoric (circa 1250 A.D.) site, and the preliminary conservation and cataloguing of artifacts.

Field Director – Crawford Lake site, Halton Region Conservation Authority. Responsible for the excavation of a longhouse and the survey and excavation of a conservation roadway.

Assistant Field Director and Acting Director – Crawford Lake Village site, Halton Region Conservation Authority. Responsible for the excavation of the prehistoric Middleport village, preliminary conservation, cataloguing and flotation.

Assistant Photographer and Designer – Responsibilities included preparation of plates for publication, developing film and PMT production.

Principal Investigator – preliminary underwater archaeological survey of Crawford Lake, Halton Region.

Archaeological Assistant – archaeological resource assessment, City of London.

1981 **MUSEUM OF INDIAN ARCHAEOLOGY**

Assistant Contract Archaeologist – Responsible for conducting archaeological resource assessments on properties scheduled for development.

Contract Archaeologist – responsible for conducting archaeological resource assessment on properties scheduled for development.

Research Associate

1981-1983 SELF-EMPLOYED

Principal Investigator – Preliminary underwater survey of the Kettle Point chert outcrops off Kettle Point, Lambton County (part of Master's thesis).

1981 to 1982 SELF-EMPLOYED

Principal Investigator – Kettle Point Chert project. Kettle Point chert samples were collected and used in a petrological study and spatial and temporal distribution analysis. Methods of investigation included thin section analysis, x-ray fluorescence, neutron activation analysis and isotopic composition analysis. Master's thesis.

1980 **MUSEUM OF INDIAN ARCHAEOLOGY**

Lab analyst – Conducted the preliminary conservation and cataloguing of the 19th century Van Egmond house materials (Seaforth, Ontario).

Assistant Field Director – prehistoric Neutral Lawson village site, London. Responsible for directing excavation, public relations and technical assistance.

Field Director – Archaic site was subject of salvage excavation utilizing waterscreens and heavy machinery.

Field Assistant – excavation of the 19th century Van Egmond House.

Assistant Field Director – multi-component site of Squaw Island in St. Lawrence Islands National park. In association with the Archaeological Survey of Canada, National Museum of Man.

1979 to 1980 **MUSEUM OF INDIAN ARCHAEOLOGY**

Research Assistant – Analysis of the Draper site castellations employing SPSS, using the DEC10 and PDP11 systems. Completed an edit of the Draper rim sherd file.

1979 **MUSEUM OF INDIAN ARCHAEOLOGY**

Research Associate.

Field Director – Upper Thames Conservation Authority. Conducted an intensive field survey of the prehistoric and historic resources in the Glengowan Dam project area and analyzed materials.

Project Director – Upper Thames Conservation Authority. Conducted a preliminary assessment of the prehistoric and historic cultural resources of the Glengowan Dam Project area.

Field Director – excavation of a Glen Meyer village located in Longwoods Conservation Area and acted as public relations liaison.

Volunteer – Fathom Five Provincial Park, Tobermory, Ontario. Mapping of the 19th century shipwreck, WETMORE.

1978 **MUSEUM OF INDIAN ARCHAEOLOGY**

Research Assistant – Researching reference material for the Museum gallery, including such topics as trade networks, ceremonial goods, settlement patterns, burial practices, and artifact types and interpretation.

1977 **MUSEUM OF INDIAN ARCHAEOLOGY**

Curatorial Assistant – Inventory and preliminary analysis of the complete Wilfred Jury collection.

Archaeological Assistant – Survey of the New Toronto International Airport proposed location, Pickering. Project objectives included locating archaeological resources and preparing a site inventory. Also conducted preliminary conservation and cataloguing of recovered materials.

Research Assistant –analysis of material recovered from the New Toronto International Airport Survey.

SCARLETT E. JANUSAS

PROJECT RELATED EXPERIENCE – CULTURAL HERITAGE ASSESSMENT

DG Group **Caledon East**
Cultural Heritage impact assessment of farm, Airport Road, subdivision (2017).

County of Bruce **Paisley**
Cultural Heritage Impact Assessment of Bridge 11, Pratt Through Truss (2017)

County of Bruce **Riversdale**
Cultural Heritage Assessment of Bridge 0002 – Pony Truss (2017)

Arcadis Canada Inc. **Thunder Bay**
Cultural Heritage Evaluation of Proposed Boulevard Lake Dan Rehabilitation.

Angil Development Group **Brantford**
Heritage Impact Assessment, Block Bounded by Wellington Street, West Street, Darling Street and Bridge Street, City of Brantford (2016)

Block 59, Vaughan **Vaughan**
Cultural Heritage Impact Assessment of Block 59 in City of Vaughan. Industrial/commercial block development (2014).

Bracebridge Power Generation **Parry Sound**
Cultural Heritage Impact Assessment of Cascade Street Power Generation Station (2014)

East Durham Wind Farm **Grey County**
Cultural Heritage Assessment for proposed Wind Farm.

Gotham/Conestogo Wind Farm **Perth and Region of Waterloo**
Cultural Heritage Assessment for proposed Wind Farm. Invenergy LLC

NextEra **Middlesex Co.**
Self-Assessment Bornish and parts of Adelaide Wind Farm (2012)

AREA Architects
2008 Cultural Heritage Assessment of former Ontario Bedding Company, Waterloo, Ontario.

AREA Architects
2009 Cultural Heritage Assessment of Hergott Cider Mill and Property, Waterloo, Ontario.

METRUS Development Inc.
2010 Cultural Heritage Impact Assessment of Two Properties in City of Brampton, Ontario.

METRUS Development Inc.

2010 Cultural Heritage Impact Assessment of Four Properties in City of Brampton, Ontario.

Penn Energy

2010 Cultural Heritage Assessment of Stewart South and Stewart North properties, Northumberland County.

Helimax

2010 Cultural Heritage Assessment of Capreol Solar Farm, Sudbury District.

Helimax

2010 Cultural Heritage Assessment of Glenarm Solar Farm, Kawartha Lakes.

GL Garrad Hassan**Sophiasburg, Prince Edward County**

Stage 1 Archaeological Assessment Sunny Shores Solar Facility (2012).

Schneider Power

2010 Cultural Heritage Assessment of Trout Creek Wind farm, Parry Sound.

GL-Garrad Hassan**Bruce County**

Heritage Screening Skyway 127 Wind Energy Inc. Bruce County (2011)

Dillon Consulting Ltd**Mono Township, Ontario**

Self- Assessment Dufferin Wind Farm 69 KV Transmission Line (2011)

Dillon Consulting Ltd**Amaranth Township, Ontario**

Self-Assessment Dufferin Wind Farm 230 KV Transmission Line (2011)

Dillon Consulting Ltd**Amaranth Township, Ontario**

Stage 1 Archaeological Assessment Dufferin Wind Farm – Additional Lands (2011)

Dillon Consulting Ltd.**Melancthon Township, Ontario**

Stage 2 Archaeological Assessment Dufferin Wind Farm Alternate #5 Turbine (2011)

Dufferin Wind Power Inc. and Dillon Consulting Ltd.**Melancthon Township, Ontario**

Self-Assessment Protected Properties, Archaeological and Heritage Resources Dufferin Wind Power Project (2011)

Dufferin Wind Power Inc. and Dillon Consulting Ltd.**Melancthon Township, Ontario**

Self-Assessment Protected Properties, Archaeological and Heritage Resources Dufferin Wind Project proposed 69KV transmission line and POI (2012)

Melancthon and Amaranth Townships, Ontario

Cultural Heritage Assessment Proposed 230 KV Transmission Line Dufferin Wind Farm (2012)

Dillon Consulting Ltd. **Melancthon Township, Ontario**
Stage 1 Arch. Ass. Dufferin Wind Farm 69 JV Transmission Line (2012)

Dillon Consulting Ltd. **Melancthon Township, Ontario**
Cultural Heritage Assessment Proposed Dufferin Wind Farm (Including proposed 230 KV and 69 KV Transmission Line) (2012)

Dillon Consulting Ltd. **Melancthon Township, Ontario**
Cultural Heritage Assessment and Stage 1&2 PRIVATE EASEMENT Proposed 230 KV Transmission Line Dufferin Wind Farm (2012)

Dufferin County, Ontario
Stage 2 Arch. Ass. Dufferin Wind Farm Layout Modifications (2012)

Canadian Solar Solutions Inc. & Dillon Consulting Ltd. **Temiskaming, Ontario**
Self-Assessment Protected Properties, Archaeological & Heritage Resources and Stage 1 Archaeological Assessment Liskeard 1, 3, & 4 Solar Farms (2011)

Capreol, Ontario
Cultural Heritage Assessment for proposed Highlight Solar Project (2011)

SkyPower Limited **Durham, Ontario**
Cultural Heritage Assessment Proposed Discovery light Solar Farm (2012)

SkyPower Limited **Durham, Ontario**
Self – Assessment Protected Properties, Arch. & Heritage Resources (2012)

SkyPower Limited **Durham, Ontario**
Self – Assessment Protected, Arch. & Heritage Resources - ILLUMINATIONLIGHT LP Solar Power Project (2012)

Sky Power Limited
Self- Assessment Protected Properties, Archaeological & Heritage Resources Fotolight LP Solar Power Project 2011)

SkyPower Limited **Dundas County, Ontario**
Self-Assessment Protected Properties and Stage 1&2, Archaeological and Heritage Resources Mighty LP Solar Power Project (2012)

SkyPower Limited **Dundas County, Ontario**
Self-Assessment Protected Properties and Stage 1&2, Archaeological and Heritage Resources CityLights LP Solar Power Project

SkyPower Limited **York County, Ontario**
Cultural Heritage Assessment, Self-Assessment, and Stage 1&2 Proposed Goldlight Solar Farm (2012)

SkyPower Limited **York County, Ontario**
Protected Properties, Archaeological and Heritage Resources Good Light LP Solar Power Project (2012)

SkyPower Limited **York County, Ontario**
Cultural Heritage Assessment, Self -Assessment, and Stage 1&2 Proposed Earthlight Solar Farm (2012)

SkyPower Limited **York County, Ontario**
Cultural Heritage Assessment, Self -Assessment, and Stage 1&2 Proposed Goldlight Solar Farm (2012) and CHIA

SkyPower Limited **York County, Ontario**
Cultural Heritage Assessment, Self -Assessment, and Stage 1&2 Proposed Beam Light Solar Farm (2012)

SkyPower Limited **Simcoe County, Ontario**
Self-Assessment, Cultural Heritage Assessment, and Stage 1&2 Archaeological Assessment for proposed Raylight Solar Farm, formerly Aria solar farm (2012).

Waste Management of Canada Corp. **Ottawa, Ontario**
Environmental Assessment for a New Landfill Footprint at the West Carleton Environmental Centre Final – Cultural Heritage Detailed Impact Assessment (2012)

**Ministry of Tourism,
Culture and Sport**

Heritage Program Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 314 7133
Fax: 416 212 1802

**Ministère du Tourisme,
de la Culture et du Sport**

Unité des programmes patrimoine
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 7133
Télé: 416 212 1802



July 9, 2018 (EMAIL ONLY)

Scarlett Janusas
Scarlett Janusas Archaeology Inc.
269 Cameron Lake Road
Tobermory, ON N0H2R0
E: jscarlett@amtelecom.net

RE: MTCS file #: 0007028
Proponent: Municipality of Brockton
Subject: Review of Bridge Street (Bridge 0002) Riversdale Cultural Heritage
Evaluation Report and Preliminary Cultural Heritage Impact
Assessment
Location: County of Grey, Ontario

Dear Ms. Janusas:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Bridge Street (Bridge 0002) Riversdale Heritage Evaluation Report and Preliminary Cultural Heritage Impact Assessment. MTCS's interest in this Environmental Assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land-based and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources.

MTCS has reviewed the Bridge Street (Bridge 0002) Riversdale Cultural Heritage Evaluation Report and Preliminary Cultural Heritage Impact Assessment revised March 31, 2018, prepared by Scarlett Janusas Archaeology Inc. and has the following comments:

1. Section 1.0 (Introduction) – This section states that “no recent formal bridge inspection has been conducted.” A section about the current bridge condition should be included, preferably in the Heritage Impact Assessment section but information could be expanded in section 5.1.5 (Condition & Modifications) Please note that bridges in Ontario are inspected following the guidelines in the Ontario's Structure Inspection Manual (OSIM) <http://www.mto.gov.on.ca/english/highway-bridges/ontario-bridges.shtml> - The HIA section should include what the findings were and recommendations from the most recent inspection of the bridge (i.e. OSIM prepared by the Ministry of Transportation, revised April 2008).
2. Section 5.3.2 (Provincial) - Please note that all properties, including bridges, owned and/or controlled by Province and identified as having cultural heritage value would be included on the list of provincial heritage properties maintained by MTCS (Part III.1 of the OHA). At this time, there is no heritage bridge identified in the Bruce County area.
3. Section 6.1 (Introduction) – Please include information that speaks to whether the bridge has been previously recognized (see section 5.3.4), please delete the last 2 paragraphs in section 6.1.

4. Table 2 (Evaluation of the Potential Impacts of Bridge Improvement Alternatives on the Cultural Heritage Resources and Identified Heritage Attributes)
 - General comment –the application of the criteria should be substantiated by the evidence and research done. Although the [MTCS Heritage Identification & Evaluation Process \(September 2014\)](#) was developed under Part III.1 of the Act, the Part 2 - Evaluation Methodology can be of assistance in understanding the application of O.Reg. 9/06
 - Criteria 1.i – please clarify the statement that “there is one provincially designated Warren truss pony bridge in Ontario” To date, no properties have been designated by the Minister of Tourism, Culture and Sport (s. 34.5 of the Ontario Heritage Act).
 - Criteria 2.i – please expand how the bridge has direct associations with an agricultural and rural community
 - Criteria 2.ii – please expand on how the bridge meets this criteria (yields, or has the potential to yield)
5. Section 6.4 (Statement of Cultural Heritage Value) – The proposed Statement should include the description of property. Please note that a SCHV will provide the following information:
 - Description of Property - briefly describes the property location so that the property can be readily ascertained.
 - CHVI - describes why the property has cultural heritage value or interest
 - Description of Heritage Attributes – a list of the key heritage attributes or elements that must be retained to conserve the CHVI. Any views or vistas that need to be identified.

For further information on preparing a Statement of Cultural Heritage Value refer to the Ontario Heritage Toolkit.
6. Section 6.6 (Conclusion) – please clarify why it is a preliminary HIA and the terminology on remediation – it is not clear whether this means replacement and/or removal of the bridge.
7. Community engagement – Key components of an environmental assessment and also part of heritage conservation framework include consultation with the public, please clarify whether this has been done as part of this report or it would be done during the environmental assessment process. Community engagement protects the public interest in identifying and protecting cultural heritage resources, while helping to ensure that any concerns are identified and appropriately addressed.

| | | |
|---|----------|---------------------------|
| Section 7.1 (Mitigation Recommendations) Table 3: the purpose of the HIA is to determine if the proposed work will impact any cultural heritage resources that have been identified. If cultural heritage resources are impacted proceed with a Schedule B or C process under the MCEA. During this process alternative solutions will be considered to address impacts to heritage attributes. Where the proposed undertaking will result in the demolition or removal of a structure, the HIA must clearly demonstrate that efforts have been made to | Analysis | Viable Option (Yes or No) |
|---|----------|---------------------------|

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. MTCS makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MTCS be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MTCS if archaeological resources are impacted by EA project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

| | | |
|--|--|--|
| mitigate the loss of CHVI. For bridges, MTCS has been recommending the application of MTO Bridge Guidelines (see section 4. Page 16). All alternatives have been considered, document why they were not feasible and that demolition or removal is the only viable option, and the last resort. The Table should not be organized by O. Reg 9/06 but rather in the context of alternatives of the bridge. Therefore, the table should be revised to: Bridge Alternatives | | |
| 1. Retain existing bridge with no major modifications | <i>This would include whether this option is feasible or not and should discuss not only from a heritage conservation but also from other aspects (structural, safety, etc).</i> | |

The revised report should be submitted for review to groups and individuals that may have an interest in the future of this bridge eg. [Brockton heritage committee](#). MTCS may have additional comments once the report is revised.

Thank you for consulting MTCS on this project, if you have any questions or need clarification please don't hesitate to contact me or Karla Barboza.

Sincerely,

Brooke Herczeg
Heritage Planner
Brooke.Herczeg@Ontario.ca

Copied to: Karla Barboza, (A) Team Lead, Heritage Program Unit, MTCS Karla.barboza@ontario.ca

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. MTCS makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MTCS be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MTCS if archaeological resources are impacted by EA project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

June 8, 2020
GMBP File: 212326

Via Email: sjohnson@brockton.ca

Brockton Heritage and Library Committee
100 Scott Street
Walkerton, ON N0G 2V0

Attention: Ms. Sarah Johnson
Committee Secretary

Re: Request for Review and Comment
Bridge No.0002 (Greenock)
Riversdale, Municipality of Brockton

Dear: Ms. Johnson

GM BluePlan Engineering Limited (GMBP) was retained by the Municipality of Brockton to undertake a planning process toward addressing the deteriorated condition of Bridge No.0002 (Greenock), situated on Bridge Street in Riversdale (Lot 30, Concession 1N), just north of Highway 9. The Municipal Engineers Association, in cooperation with the Ministry of the Environment, Conservation and Parks (MECP), has developed a Municipal Class Environmental Assessment (EA) process to assist in planning projects of this nature.

The Municipal Class EA outlines a comprehensive planning process that provides a rational approach to consider the advantages and disadvantages of various alternatives on several 'environments' in order to determine a *Preferred Solution* to address an identified problem (or opportunity). The assessment process is to include consideration for the technical, social, natural heritage, cultural and economic implications and potential mitigation measures. The process also involves consultation with various government agencies, indigenous communities and the public. Based on feedback from the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) regarding the Cultural Heritage assessments for similar projects, we are requesting that the Brockton Heritage and Library Committee review and provide comment on the Cultural Heritage Evaluation Report which was prepared as part of the background documentation for the process.

REQUEST FOR REVIEW AND COMMENT

A key part of the heritage conservation framework includes consultation with groups that may have a potential interest in the future of a given structure. As a result, the Brockton Heritage and Library Committee is being requested to review and provide comment on the Cultural Heritage Evaluation Report and Preliminary Heritage Impact Assessment for Bridge No.0002 (Riversdale), prepared by Scarlett Janusas Archaeology Inc. (July 21, 2017, revised August 25, 2018), herein referred to as the CHER/HIA. A copy of the report is enclosed, and a summary of the findings is provided herein.

The findings of the CHER/HIA are used to inform the cultural heritage 'environment' of the alternatives considered for the Riversdale Bridge EA Process, including bridge replacement, rehabilitation or removal. We expect that the MHSTCI will request that the local Heritage Advisory Committee be included in the consultation efforts for this undertaking. Therefore, we are requesting the Brockton Heritage and Library Committee to confirm the following:

- ☐ That the Brockton Heritage and Library Committee has reviewed the CHER/HIA (revised August 2018).

- ☐ The Brockton Heritage and Library Committee supports (or otherwise) the conclusions with respect to the cultural heritage value assigned to the Riversdale Bridge.
- ☐ The Brockton Municipal Heritage Committee supports (or otherwise) the removal and/or replacement of the Riversdale Bridge.
- ☐ The Brockton Municipal Heritage Committee supports (or otherwise) the mitigation measures proposed in the CHER/HIA (summarized below) for the alternative(s) being considered at this time.

SUMMARY OF FINDINGS AND RECOMMENDATIONS (CHER/HIA)

Cultural heritage assessments are required as part of the EA planning process which necessitates *'the conservation of features of significant architectural, cultural, historical, archaeological or scientific interest'*. The CHER/HIA was completed to inform the cultural heritage aspects of the Riversdale Bridge Environmental Assessment process. A summary of the findings is provided below.

Report Findings

Based on a search of the of the municipal, provincial and federal registers, Riversdale Bridge is not designated as being a property of cultural heritage value or interest. However, to determine the potential cultural heritage value of the subject bridge the "Criteria for Determining Cultural Heritage Value or Interest" set out in Ontario Regulation 9/06 under the Ontario Heritage Act (OHA), as amended in 2005, were used. The CHER identified that the bridge met several of the cultural heritage assessment criteria. Input from the local Heritage Committee is being sought to gauge the degree of local interest in these elements.

Design or Physical Value

The bridge is representative of a single-span, 8-panel, rivet-connected Pratt through-truss bridge. Heritage attributes identified, specific to the subject bridge include the following:

- i. Cast-in-place concrete abutments;
- ii. Steel, single span with 8-panel design;
- iii. Rivet-connected skeletal framework, including diagonal steel members and horizontal bracing; and
- iv. Timber deck beams (replaced in 2003).

At this time, the Riversdale Bridge is one of four remaining metal rivet-connected Pratt through-truss bridges in Bruce County. Other similar bridges within the County include the following:

1. **Kolb Bridge (7-Panel):**

This single-span bridge is situated approximately 35 km north of Riversdale, directly south of Port Elgin, in the Town of Saugeen Shores.

2. **Watson's Bridge (7-Panel):**

This bridge, which was repaired in 2015, is located approximately 20 km north-northwest of Riversdale along the Greenock-Elderslie Townline Road and is maintained by the County of Bruce. It crosses over the Teeswater River south of Paisley.

3. **Old CR-3 Bridge (8-Panel):**

This two-span Pratt through-truss bridge is reportedly noted for its *'high degree of historic integrity with no major alterations'* (Historic Bridges Webpage). It is located approximately 42 km north of Riversdale in the Municipality of Saugeen Shores. Although the bridge no longer supports vehicular traffic, it has been left in-situ for off-road and non-motorized use only and a new vehicular bridge was constructed nearby.

In addition, approximately 12 kilometres northeast of Riversdale, north of Chepstow, there remains a similar 8-panel Pratt through-truss bridge commonly referred to as the Concession Road 8 Bridge. However, while the majority of the metal truss bridges have riveted connections, the Concession 8 Bridge has pinned connections which are considered less common.

Preliminary investigations suggest that within the surrounding area several other similar Pratt through-truss bridges remain including five (5) in Grey County, three (3) in Wellington County, two (2) in Huron County and one in Perth County.

Historical or Associative Value:

The Riversdale Bridge demonstrates the work or ideas of a builder (or designer/engineer) that may be significant to the community. The bridge was built by the Hunter Bridge & Boiler Company of Kincardine which was established in 1887 by the Hunter brothers. Alexander and Robert Hunter were reportedly born in Brant County (i.e. near Hamilton) in 1851 and 1846, respectively, and moved to Bruce County in 1856.

The bridge may have direct associations with a theme that may be significant to the community or may have the potential to yield information that contributes to the understanding of the community as it served as an early transportation route serving the local agricultural community.

Contextual Value

The bridge contributes to the landscape character of the area, emphasizing its function to serve as a conduit to areas on either side of the Teeswater River.

The CHER concluded that *"the bridge has been evaluated as having cultural heritage value and interest"*.

We request that the Brockton Heritage and Library Committee review these findings and provide concurrence or other commentary.

Proposed Mitigation Measures

A preliminary Heritage Impact Assessment (HIA) was also included in the CHER, better to inform the alternatives that will be considered in the EA process. In consideration of the *Ontario Heritage Bridge Guidelines Conservation Options*, there are several mitigation options that may be considered for the alternatives under review. It is noted that based on recent inspection reports it is our opinion that it is unlikely that bridge rehabilitation will be a viable option for this structure, due to the significant cost, marginal increase in life span, and the low traffic volume on this road. Therefore, the mitigation measures outlined below focus on two alternatives, including bridge removal and bridge replacement. Mitigation measures considered for these alternatives include the following:

- i. Commemoration: The Municipality may consider the preparation of a historical plaque (or monument) to commemorate the cultural heritage associated with the Riversdale Bridge for permanent installation at the Site.
- ii. Documentation: The history of the Riverdale Bridge is contained within the CHER/HIA. No known original drawings of the structure have been located, however, general schematic drawings of rivet-connected Pratt through-truss bridges and photos of the existing structure are contained within the CHER/HIA. As a mitigation measure, it is recommended that the CHER/HIA (revised August 25, 2018), and other relevant reports, form the documentation for Bridge No. 0002. Furthermore, it is recommended that a hard copy or digital copy be deposited, as a single documentation report, at the Walkerton Branch of the Bruce County Library System and at the Bruce County Museum and Cultural Centre.

AND/OR

- iii. Salvage elements for incorporation into new structure, conservation and/or displays (latter could include heritage parks, museums etc.).



We request that the Brockton Heritage and Library Committee consider these mitigation measures and provide concurrence, or other commentary.

Should you have any questions, please feel free to contact the undersigned.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in blue ink that reads 'Melissa Robinson'.

for Andrea Nelson, M.Sc.
AN/mr

cc: File No. 212326

RELEVANT DOCUMENTATION

Copy of the Cultural Heritage Evaluation Report and Preliminary Heritage Impact Assessment for Bridge No.0002, prepared by Scarlett Janusas Archaeology Inc. (July 21, 2017; Revised August 25, 2018).

Drea Nelson - GM BluePlan

From: Sarah Johnson <SJohnson@brockton.ca>
Sent: Tuesday, September 15, 2020 10:09 AM
To: Drea Nelson - GM BluePlan
Cc: Jesse Borges - GM BluePlan; Brent Willis - GM BluePlan; Fiona Hamilton
Subject: RE: 212326 Brockton Heritage and Library Committee: Request for Review and Comment

Good morning Drea,

The Brockton Heritage Committee met last night (September 14, 2020), and passed the following Resolution:

Moved by Dean Leifso Seconded by Barb Kerry

That the Brockton Heritage Committee recommends the preferred Option #1 for the heritage and conservation of Bridge No. 0002, subject to additional cost analysis of the various options.

Carried.

I have copied Fiona Hamilton, our Clerk in this email since she was present at the Heritage Committee Meeting and can provide further information if necessary.

Thank you,

Sarah Johnson
Jr. Deputy Clerk

Phone: 519-881-2223 Ext. 159
Email: sjohnson@brockton.ca

Municipality of Brockton
100 Scott Street, P.O. Box 68,
Walkerton, ON N0G 2V0

Toll-Free: 1-877-885-8084
Fax: 519-881-2991

Brockton.ca



Prepared By:



Municipality of Brockton: Greenock Structure No.0002

Cultural Heritage Evaluation Report and Preliminary HIA (ADDENDUM) and Heritage Impact Assessment

GMBP File: 212326

October 22, 2020



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ATTACHMENTS

ATTACHMENT A: MHSTCI CORRESPONDENCE

ATTACHMENT B: BRIDGE INSPECTION REPORT (APRIL 2020)

ATTACHMENT C: BROCKTON MUNICIPAL HERITAGE COMMITTEE

CULTURAL HERITAGE EVALUATION REPORT AND PRELIMINARY HIA (ADDENDUM) AND HERITAGE IMPACT ASSESSMENT

MUNICIPALITY OF BROCKTON: GREENOCK STRUCTURE NO.0002

OCTOBER 22, 2020

GMBP FILE: 212326

1. INTRODUCTION

The Municipality of Brockton is undertaking a Schedule 'B' Environmental Assessment (EA) via the Municipal Class EA Process to address the deteriorated condition of Bridge No. 0002 (Greenock), also known as the Riversdale Bridge, which is located on Bridge Street, east of Highway 9 in the Hamlet of Riversdale.

Cultural Heritage assessments are required to satisfy Section 2(d) of the Planning Act which necessitates '*the conservation of features of significant architectural, cultural, historical, archaeological or scientific interest*'. The Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) requires evaluation under O.Reg.9/06. Scarlett Janusas Archaeology Inc. was retained to complete a Cultural Heritage Evaluation Report (CHER) and a Preliminary Heritage Impact Assessment (HIA) for Bridge No.0002. A copy of the Report, revised August 25, 2018, is included in Appendix F of the Schedule 'B' Project File for the Riversdale Bridge. This Addendum to the subject report (i.e. CHER/HIA), which is prepared to satisfy the outstanding issues outlined by the MHSTCI in correspondence dated July 9, 2018 (provided in **Attachment A**), addresses the following:

- i. Provides a response to the outstanding MHSTCI outlined in the July 9, 2018 correspondence.
- ii. Provides a summary of the Municipality's community engagement efforts, including consultation with the Brockton Heritage and Library Committee.
- iii. Provides a Heritage Impact Assessment based on the *Preliminary Recommended Solution* to the Schedule 'B' Environmental Assessment, including a more specific review of the potential impacts and mitigation measures.

2. CHER UPDATE: RESPONSE TO MHSTCI COMMENTS

Ministry comments were summarized in correspondence issued on July 9, 2018 regarding the CHER/HIA for the Riversdale Bridge and are provided in **Attachment A**. While some of the comments were addressed in the Revised CHER/HIA (August 25, 2018), some remain outstanding. This Section addresses the outstanding comments for MHSTCI review.

1. Section 1.0 (Introduction):

MHSTCI Comment: *"This section states that 'no recent formal bridge inspection has been conducted'. A section about the current bridge condition should be included, preferably in the Heritage Impact Assessment Section".*

GMBP Response

Bridge Inspection reports are included in Appendix C of the Project File. A copy of the most recent Inspection Report, outlining the findings of the inspection completed in April 2020, is provided in **Attachment B** for reference purposes. A brief description the current bridge condition has been included as part of the HIA, provided in this Addendum (i.e. **Section 4**).

As noted in recent inspection reports for the bridge, the structure, including the abutments and wingwalls, is visibly in fair to poor condition. To date, several repairs have been completed. More specifically, in 2003 the timber deck and steel stringers were removed and replaced with new steel stringers and pressure treated timber deck boards along the full length of the structure. In addition, some repairs were completed on the steel bridge trusses and a concrete cap was placed on the ballast wall. Further, in 2012 minor repairs were completed on the steel structure within an area of impact damage on the upper braces of the structure.

Until recently, inspection reports supported the continued use of the structure, with a triple load posting of 8, 13, and 21 tonnes. However, the most recent inspection completed in April 2020 indicated that the floor beams below the deck are exhibiting severe corrosion and section loss, thereby significantly reducing the overall load carrying capacity of the bridge. As a result, it was recommended that the structure be removed or replaced within one-year. Further, the OSIM report recommended that the bridge be closed to all vehicular traffic in the interim. As such, the Municipality closed the bridge on June 1, 2020.

2. Section 5.3 (Comparative Analysis):

In general, it is our understanding that clarification regarding the comparative geographic context of rivet-connected Pratt through truss bridges is required.

GMBP Response

At this time, the Riversdale Bridge is one of four remaining metal rivet-connected Pratt through truss bridges in Bruce County. Other similar bridges within the County include the following:

1. Kolb Bridge (7-Panel):

This single-span bridge is situated approximately 35 km north of Riversdale, directly south of Port Elgin, in the Town of Saugeen Shores.

2. Watson's Bridge (7-Panel):

This bridge, which was repaired in 2015, is located approximately 20 km north-northwest of Riversdale along the Greenock-Elderslie Townline Road and is maintained by the County of Bruce. It crosses over the Teeswater River south of Paisley.

3. Old CR-3 Bridge (8-Panel):

This two-span Pratt through truss bridge is reportedly noted for its *'high degree of historic integrity with no major alterations'* (Historic Bridges Webpage). It is located approximately 42 km north of Riversdale in the Municipality of Saugeen Shores. Although the bridge no longer supports vehicular traffic, it has been left in-situ for off-road and non-motorized use only and a new vehicular bridge was constructed nearby.

In addition, approximately 12 kilometres northeast of Riversdale, north of Chepstow, there remains a similar 8-panel Pratt through truss bridge commonly referred to as the Concession Road 8 Bridge. However, while the majority of the remaining metal truss bridges have riveted-connections, the Concession 8 Bridge has pinned-connections, which are considered less common.

3. Section 6.6 (Conclusion):

MHSTCI Comment: *'Please clarify why it is a preliminary HIA and the terminology on remediation – it is not clear whether this means replacement and/or removal of the bridge'.* More specifically, it is GMBP's understanding that, because the MHSTCI received the CHER/HIA prior to the *Notice of Project Initiation* being issued for this project, the MHSTCI considered a heritage impact assessment to be premature.

GMBP Response

As part of the EA process, several background studies are requisitioned to inform the impacts of the alternative solutions considered for the project on the various 'environments' (i.e. Social, Technical, Natural, Cultural and Economic). With the exception of the Archaeological Assessment, which is to be submitted to the Ministry in accordance with Part IV of the Ontario Heritage Act, R.S.O., c0.18, the background studies are intended to form part of the Environmental Assessment Project File (or Environmental Study Report) and be circulated to the public, stakeholders, agencies and Indigenous Communities in conjunction with the Project Notices (i.e. *Notice of Project Initiation*).

The issuance of the CHER/HIA report for the Riversdale Bridge by the subconsultant, prior to the issuance of the *Notice of Project Initiation*, was not intended. The preliminary HIA, when included as part of the Project File, is used to identify where a project alternative may have an impact on an identified cultural heritage resource, and considers preliminary mitigation measures, which should be considered in the context of the overall project planning process.

3. COMMUNITY ENGAGEMENT

3.1 Environmental Assessment Schedule 'B' Process Consultations

Community engagement is being completed as part of the Schedule 'B' Environmental Assessment process that is being completed for the Riversdale Bridge. As part of this process, a *Notice of Project Initiation and Invitation to Virtual Public Information Centre* was issued on October 22, 2020. Project notices are advertised in the Walkerton Herald-Times and the Hanover Post and are circulated to agencies and Indigenous Communities. In addition, project notices are also mailed to property owners in the area surrounding the bridge. The Notices include information pertaining to how the Project File, which includes a copy of the CHER/HIA, can be viewed (i.e. a link to the report or on the Municipality website). Circulation lists summarizing the consultation efforts completed in conjunction with the EA process are provided in Appendix A of the Riversdale Bridge Project File. A final project notice will be issued as part of the *Notice of Completion* specific to this EA.

3.2 Brockton Heritage and Library Committee

In June 2020 the Municipality requested the Brockton Heritage and Library Committee to review the Cultural Heritage Evaluation Report and Preliminary Heritage Impact Assessment for the Riversdale Bridge (i.e. Greenock Structure No.0002). A copy of the report was provided to facilitate their review process. As part of the review process, the Heritage Committee was specifically requested to confirm the following:

- ☐ The Brockton Heritage and Library Committee reviewed the CHER/HIA (revised August 2018).
- ☐ The Brockton Heritage and Library Committee supports (or otherwise) the conclusions with respect to the cultural heritage value assigned to the Riversdale Bridge.
- ☐ The Brockton Heritage and Library Committee supports (or otherwise) the removal and/or replacement of the Riversdale Bridge.
- ☐ The Brockton Heritage and Library Committee supports (or otherwise) the mitigation measures proposed in the CHER/HIA for the alternative(s) being considered.

Following the Heritage Committee meeting on September 14th, 2020, the committee indicated that they concurred with the mitigation measures proposed, namely commemoration of the structure (i.e. Option 1). This consultation correspondence is included in **Attachment C**. This feedback from the Heritage Committee is reflected in the updated Heritage Impact Assessment, presented below.

4. HERITAGE IMPACT ASSESSMENT

4.1 Cultural Heritage Value

The Municipality of Brockton is seeking to address the deteriorated condition of the Riversdale Bridge (i.e. Greenock Structure No.0002). The structure is located in the Hamlet of Riversdale, between Walkerton and Kincardine, north of Provincial Highway 9. The structure is visibly in fair to poor condition, as is noted in the recent inspection reports for the bridge. A copy of the most recent Inspection Report outlining the findings of the inspection completed in April 2020 is provided in **Attachment B**.

Based on the information available, the structure is a steel 8-panel rivet-connected Pratt through truss bridge with steel floor beams and stringers supporting a laminated timber deck. Although it is not known how the existing structure is founded (i.e. piles or spread footings), the bridge is supported by cast in place concrete abutments and wingwalls with an overall span of 37.1 meters. The overall width of the existing structure is approximately 4.25m with flex beam guiderails on each side. The flex beams are fastened directly to the steel truss. The available clear roadway width is approximately 4.0 meters which accommodates one lane of traffic. To date, several repairs have been completed including repairs to the steel bridge structure and concrete substructure, as well as the replacement of the steel stringers and timber deck boards. The deteriorated condition of the bridge is being addressed by the Municipality to avoid a potential collapse.

Based on the results of the cultural heritage evaluation, the Riversdale Bridge was determined to retain some cultural heritage value. In general, its heritage value centres on the following:

- (i) Its historical relationship with the Hunter Bridge and Boiler company of Kincardine which was established by the Hunter Brothers in 1887. Alexander and Robert Hunter were reportedly born in Brant County (near Hamilton) and moved to Bruce County in 1856. This bridge reflects one of the bridges built by this locally owned and operated company;
- (ii) The bridge design which is representative of a rivet-connected Pratt through truss structure and associated physical attributes; and
- (iii) Its historical and visual link to the surrounding area, as it contributes to the landscape character of the area.

As such, the structure was found to meet at least one of the criteria of Regulation 9/06 under the *Ontario Heritage Act* (OHA).

4.2 Environmental Assessment: Recommended Solution

The Municipality of Brockton initiated a Class Environmental Assessment process to develop, identify and evaluate alternatives to address the deteriorated condition of the Riversdale Bridge. The study is being completed in accordance with the Municipal Class Environmental Assessment (October 2000, as amended 2007, 2011 and 2015) as a Schedule 'B' project. Based on the *Preliminary Recommended Solution* to the Schedule 'B' EA for the Riversdale Bridge, the Municipality is proposing to remove the existing bridge. Bridge removal has the potential to impact the identified cultural heritage values and/or attributes associated with the structure.

Given the identified cultural heritage value of the Riversdale Bridge, a Heritage Impact Assessment is provided herein to more specifically evaluate the potential impacts and mitigation strategies that may be considered to preserve the identified heritage attributes of the structure. It is noted that of the nine conservation options presented in **Section 4.3.1**, only two are applicable to bridge replacement/removal (i.e. Conservation Options 8 and 9).

While Conservation Option 8, removal of the heritage bridge with salvage of elements for incorporation into new structure for future conservation work or displays is technically feasible, the size (i.e. length of greater than 30-feet) would make this potential mitigation option very expensive for the Municipality. Further, the Brockton Heritage and Library Committee did not indicate that the preservation of components (or elements) from the existing structure was of interest. Therefore, Conservation Option 9, removal of the existing bridge with full recording and documentation of the heritage structure, is considered appropriate for this undertaking. As such, impacts to this heritage resource are expected.

It is also noted that Conservation Option 5, retention of the bridge for pedestrian walkways, cycle paths, scenic viewing etc., was evaluated within the framework of the Project File. Following a detailed review, and in consideration of the technical and economic implications, this alternative was not recommended.

4.3 Evaluation of Alternatives and Potential Impacts

4.3.1 Alternatives to be Considered for a Heritage Bridge

The CHER determined through the application of the '*Criteria for Determining Cultural Heritage Value or Interest*' under Ontario Regulation 9/06 that the subject structure retains some cultural heritage value. The following nine conservation options/alternatives are arranged according to the level or degree of intervention from minimum to maximum. The conservation options are based on the Ontario Heritage Bridge Program (1991), which is reportedly regarded as current best practice for conserving heritage bridges in Ontario and ensures that heritage concerns, and appropriate mitigation options, are considered.

1. Retention of existing bridge and restoration of missing or deteriorated elements where physical or documentary evidence (e.g., photographs or drawings) can be used for their design;
2. Retention of existing bridge with no major modifications undertaken;
3. Retention of existing bridge with sympathetic modification;
4. Retention of existing bridge with sympathetically designed new structure in proximity;
5. Retention of existing bridge no longer in use for vehicular purposes but adapted for pedestrian walkways, cycle paths, scenic viewing etc.;
6. Relocation of bridge to appropriate new site for continued use or adaptive re-use;
7. Retention of bridge as heritage monument for viewing purposes only;
8. Replacement/removal of existing bridge with salvage elements/members of heritage bridge for incorporation into new structure for future conservation work or displays; and
9. Replacement/removal of existing bridge with full recording and documentation of the heritage bridge.

4.3.2 Impact Assessment

To assess the potential impacts of a proposed project on the cultural heritage value of a structure, the identified heritage attributes are considered against a range of possible impacts as outlined in the MTCS document entitled 'Screening for Impacts to Built Heritage and Cultural Heritage Landscapes' (November 2010), which include:

- Destruction of any, or part of any, significant heritage attribute or feature.
- Alteration which means a change in any manner and includes restoration, renovation, repair or disturbance.
- Shadows created that alter the appearance of a heritage attribute or change the visibility of a natural feature of plantings, such as a garden.
- Isolation of a heritage attribute from its surrounding environment, context, or a significant relationship.
- Direct or indirect obstruction of significant views or vistas from, within, or to a built and natural feature.
- A change in land use such as rezoning a battlefield from open space to residential use, allowing new development or site alteration to fill in the formerly open spaces.
- Soil disturbance such as a change in grade, or an alteration of the drainage pattern or excavation etc.

Provided that the bridge was found to retain some cultural heritage value under O.Reg.9/06, the potential impacts associated with the nine conservations options were considered as part of the preliminary impact assessment presented in Table 3 of the CHER/HIA (revised August 2018). The preliminary overview of potential impacts, when included as part of the Project File, was used to identify where a project alternative may have an impact on an identified heritage attribute, and outlined mitigation measures, which were considered in the context of the overall EA planning process.

4.4 Evaluation of Potential Impacts of Bridge Removal on the Cultural Heritage Resource

Based on the range of possible impacts outlined in **Section 4.3.2** of this document, an assessment of the potential impacts of the proposed bridge removal on the cultural heritage attributes identified for the Riversdale Bridge is provided in the following Table 1.

TABLE 1 (HIA): Impact Assessment for Riversdale Bridge (Greenock Structure No.0002)

| Impact | Potential Impacts of the Proposed Bridge Removal |
|---|--|
| Destruction, Removal or Re-location | Bridge removal is recommended, this would have an impact the design/physical nature of the structure, namely the heritage attributes associated with the bridge. |
| Alteration | Yes, alterations to the bridge are expected through removal. |
| Shadows | No Impact. |
| Isolation | The proposed removal will impact the relationship of the structure with the surrounding environment and context. |
| Direct or Indirect obstruction of significant views | No significant impacts to the views are expected. The bridge is not visible from the well travelled Provincial Highway to the south and County Road to the east. |
| A change in land use | No Impact. |
| Soil Disturbance | Yes, minor impacts are expected through the removal of the existing structure from its current location. Naturalized river banks will be restored. |

4.5 Conclusions and Mitigation Recommendations

The Municipality is seeking to address the deteriorated condition of the Riversdale Bridge. The structure is located in the Hamlet of Riversdale, between Walkerton and Kincardine, south of Provincial Highway 9. Based on the results of the cultural heritage evaluation, the structure was found to meet at least one of the criteria of O.Reg.9/06 under the Ontario Heritage Act (OHA). As such, the Riversdale Bridge was determined to retain some cultural heritage value.

The heritage significance of the structure centres on its historical relationship with the Hunter Bridge and Boiler Company, based out of Kincardine and owned by Alexander and Robert Hunter, its design/physical attributes, and its historical link as an early water crossing connecting Riversdale with the agricultural community to the east of the Teeswater River.

Based on a review of the alternatives for the Riversdale Bridge considered as part of the EA process, which included bridge rehabilitation, replacement and removal, Conservation Option 9, bridge removal with full recording and documentation of the heritage bridge, was recommended. As a result, impacts to this heritage resource are expected.

In general, when the nature of the proposed works is such that adverse impacts are unavoidable (i.e. public safety, cost, etc.), it is necessary to implement management or mitigation strategies that alleviate the detrimental effects to the cultural heritage resource. Mitigation measures are intended to lessen (or negate) anticipated impacts to cultural heritage attributes identified. In consideration of bridge removal, the following mitigation measures are recommended for the Riversdale Bridge:

1. Commemoration:

It is recommended that the Municipality of Brockton consider the preparation of a historical plaque (or monument) to commemorate the cultural heritage associated with the Riversdale Bridge for installation at the site. This option was considered to appropriately address the cultural heritage of the structure by the Brockton Heritage and Library Committee.

2. Documentation:

The history of the Riversdale Bridge is contained within the CHER/HIA. No known original drawings of the structure have been located, however, general schematic drawings of rivet-connected Pratt through-truss bridges and photos of the existing structure are contained within the CHER/HIA. As a mitigation measure, it is recommended that the CHER/HIA (July 21, 2017 Revised August 25, 2018), including this addendum, form the documentation for the Riversdale Bridge. Further, it is recommended that a hard copy or digital copy be deposited, as a single documentation report, in the Walkerton Branch of the Bruce County Public Library System and the Bruce County Museum and Cultural Centre.

**ATTACHMENT A:
MHSTCI CORRESPONDENCE**

**Ministry of Tourism,
Culture and Sport**

Heritage Program Unit
Programs and Services Branch
401 Bay Street, Suite 1700
Toronto ON M7A 0A7
Tel: 416 314 7133
Fax: 416 212 1802

**Ministère du Tourisme,
de la Culture et du Sport**

Unité des programmes patrimoine
Direction des programmes et des services
401, rue Bay, Bureau 1700
Toronto ON M7A 0A7
Tél: 416 314 7133
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July 9, 2018 (EMAIL ONLY)

Scarlett Janusas
Scarlett Janusas Archaeology Inc.
269 Cameron Lake Road
Tobermory, ON N0H2R0
E: jscarlett@amtelecom.net

RE: MTCS file #: 0007028
Proponent: Municipality of Brockton
Subject: Review of Bridge Street (Bridge 0002) Riversdale Cultural Heritage
Evaluation Report and Preliminary Cultural Heritage Impact
Assessment
Location: County of Grey, Ontario

Dear Ms. Janusas:

Thank you for providing the Ministry of Tourism, Culture and Sport (MTCS) with the Bridge Street (Bridge 0002) Riversdale Heritage Evaluation Report and Preliminary Cultural Heritage Impact Assessment. MTCS's interest in this Environmental Assessment (EA) project relates to its mandate of conserving Ontario's cultural heritage, which includes:

- Archaeological resources, including land-based and marine;
- Built heritage resources, including bridges and monuments; and,
- Cultural heritage landscapes.

Under the EA process, the proponent is required to determine a project's potential impact on cultural heritage resources.

MTCS has reviewed the Bridge Street (Bridge 0002) Riversdale Cultural Heritage Evaluation Report and Preliminary Cultural Heritage Impact Assessment revised March 31, 2018, prepared by Scarlett Janusas Archaeology Inc. and has the following comments:

1. Section 1.0 (Introduction) – This section states that “no recent formal bridge inspection has been conducted.” A section about the current bridge condition should be included, preferably in the Heritage Impact Assessment section but information could be expanded in section 5.1.5 (Condition & Modifications) Please note that bridges in Ontario are inspected following the guidelines in the Ontario's Structure Inspection Manual (OSIM) <http://www.mto.gov.on.ca/english/highway-bridges/ontario-bridges.shtml> - The HIA section should include what the findings were and recommendations from the most recent inspection of the bridge (i.e. OSIM prepared by the Ministry of Transportation, revised April 2008).
2. Section 5.3.2 (Provincial) - Please note that all properties, including bridges, owned and/or controlled by Province and identified as having cultural heritage value would be included on the list of provincial heritage properties maintained by MTCS (Part III.1 of the OHA). At this time, there is no heritage bridge identified in the Bruce County area.
3. Section 6.1 (Introduction) – Please include information that speaks to whether the bridge has been previously recognized (see section 5.3.4), please delete the last 2 paragraphs in section 6.1.

4. Table 2 (Evaluation of the Potential Impacts of Bridge Improvement Alternatives on the Cultural Heritage Resources and Identified Heritage Attributes)
 - General comment –the application of the criteria should be substantiated by the evidence and research done. Although the [MTCS Heritage Identification & Evaluation Process \(September 2014\)](#) was developed under Part III.1 of the Act, the Part 2 - Evaluation Methodology can be of assistance in understanding the application of O.Reg. 9/06
 - Criteria 1.i – please clarify the statement that “there is one provincially designated Warren truss pony bridge in Ontario” To date, no properties have been designated by the Minister of Tourism, Culture and Sport (s. 34.5 of the Ontario Heritage Act).
 - Criteria 2.i – please expand how the bridge has direct associations with an agricultural and rural community
 - Criteria 2.ii – please expand on how the bridge meets this criteria (yields, or has the potential to yield)
5. Section 6.4 (Statement of Cultural Heritage Value) – The proposed Statement should include the description of property. Please note that a SCHV will provide the following information:
 - Description of Property - briefly describes the property location so that the property can be readily ascertained.
 - CHVI - describes why the property has cultural heritage value or interest
 - Description of Heritage Attributes – a list of the key heritage attributes or elements that must be retained to conserve the CHVI. Any views or vistas that need to be identified.

For further information on preparing a Statement of Cultural Heritage Value refer to the Ontario Heritage Toolkit.
6. Section 6.6 (Conclusion) – please clarify why it is a preliminary HIA and the terminology on remediation – it is not clear whether this means replacement and/or removal of the bridge.
7. Community engagement – Key components of an environmental assessment and also part of heritage conservation framework include consultation with the public, please clarify whether this has been done as part of this report or it would be done during the environmental assessment process. Community engagement protects the public interest in identifying and protecting cultural heritage resources, while helping to ensure that any concerns are identified and appropriately addressed.

| | | |
|---|----------|---------------------------|
| Section 7.1 (Mitigation Recommendations) Table 3: the purpose of the HIA is to determine if the proposed work will impact any cultural heritage resources that have been identified. If cultural heritage resources are impacted proceed with a Schedule B or C process under the MCEA. During this process alternative solutions will be considered to address impacts to heritage attributes. Where the proposed undertaking will result in the demolition or removal of a structure, the HIA must clearly demonstrate that efforts have been made to | Analysis | Viable Option (Yes or No) |
|---|----------|---------------------------|

It is the sole responsibility of proponents to ensure that any information and documentation submitted as part of their EA report or file is accurate. MTCS makes no representation or warranty as to the completeness, accuracy or quality of the any checklists, reports or supporting documentation submitted as part of the EA process, and in no way shall MTCS be liable for any harm, damages, costs, expenses, losses, claims or actions that may result if any checklists, reports or supporting documents are discovered to be inaccurate, incomplete, misleading or fraudulent.

Please notify MTCS if archaeological resources are impacted by EA project work. All activities impacting archaeological resources must cease immediately, and a licensed archaeologist is required to carry out an archaeological assessment in accordance with the Ontario Heritage Act and the Standards and Guidelines for Consultant Archaeologists.

If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

| | | |
|--|--|--|
| mitigate the loss of CHVI. For bridges, MTCS has been recommending the application of MTO Bridge Guidelines (see section 4. Page 16). All alternatives have been considered, document why they were not feasible and that demolition or removal is the only viable option, and the last resort. The Table should not be organized by O. Reg 9/06 but rather in the context of alternatives of the bridge. Therefore, the table should be revised to: Bridge Alternatives | | |
| 1. Retain existing bridge with no major modifications | <i>This would include whether this option is feasible or not and should discuss not only from a heritage conservation but also from other aspects (structural, safety, etc).</i> | |

The revised report should be submitted for review to groups and individuals that may have an interest in the future of this bridge eg. [Brockton heritage committee](#). MTCS may have additional comments once the report is revised.

Thank you for consulting MTCS on this project, if you have any questions or need clarification please don't hesitate to contact me or Karla Barboza.

Sincerely,

Brooke Herczeg
Heritage Planner
Brooke.Herczeg@Ontario.ca

Copied to: Karla Barboza, (A) Team Lead, Heritage Program Unit, MTCS Karla.barboza@ontario.ca

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If human remains are encountered, all activities must cease immediately and the local police as well as the Registrar, Burials of the Ministry of Government and Consumer Services (416-326-8800) must be contacted. In situations where human remains are associated with archaeological resources, MTCS should also be notified to ensure that the site is not subject to unlicensed alterations which would be a contravention of the Ontario Heritage Act.

ATTACHMENT B:
BRIDGE INSPECTION REPORT (APRIL 2020)

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Summary Action Report

Inspection Date: 4/24/2020

Bridge Condition Value (BCI) 33

Next Biennial Inspection: 4/24/2022

Performance Deficiencies

| Element Group | Element Name | Performance Deficiency |
|---------------|----------------|-----------------------------|
| Abutments | Abutment Walls | Load carrying capacity |
| Abutments | Wingwalls | Load carrying capacity |
| Approaches | Barriers | Pedestrian/vehicular hazard |
| Barriers | Hand Railings | Load carrying capacity |
| Beams | Floor Beams | Load carrying capacity |

Maintenance Needs

Repair/Rehabilitation

| Element Group | Element Name | Repair/Rehabilitation | Priority | Est. Cost |
|----------------------------------|---------------------------------|---|----------|-------------|
| Abutments | Abutment Walls | Replace entire bridge substructure. | <1 Year | \$75,000 |
| Approaches | Barriers | Replace guiderail system and install code compliant end treatments. | <1 Year | \$39,000 |
| Approaches | Wearing Surface | Pave approaches and bridge deck top during bridge replacement. | <1 Year | \$10,000 |
| Decks | Deck Top | Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal. | <1 Year | \$720,000 |
| Embankments & Streets | Embankments | Embankments to be excavated and reconstructed during bridge replacement. | <1 Year | \$80,000 |
| Foundations | Foundation (below ground level) | Replace bridge foundations. | <1 Year | \$79,000 |
| Total Repair/Rehabilitation Cost | | | | \$1,003,000 |
| Total Associated Work Cost | | | | \$368,000 |
| Total Cost | | | | \$1,371,000 |

Overall Comments

The structure appears to be in fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed. The floor beams below the deck are exhibiting severe corrosion and section loss which has reduced the load carrying capacity of the bridge. The concrete substructure appears to be in overall fair to poor condition with severe to very severe cracking, spalling and delaminations. The overall stability of the concrete abutments and wingwalls (especially west side) is questionable. We recommend that the structure be removed or replaced within 1 year. Until construction can be scheduled, we recommend that the bridge be closed to all vehicle traffic due to a load carrying capacity concern.

Additional Investigations

\$0.00

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Inventory Data:

| | | | |
|----------------------------|------------------------------|--|---|
| Structure Name | Riversdale Bridge | | |
| Main Hwy/Road # | Side Road 20 | On <input checked="" type="checkbox"/> Under <input type="checkbox"/> | Crossing Type: Nav Water <input type="checkbox"/> Non Nav Water <input checked="" type="checkbox"/> |
| Hwy/Road Name | | Rail <input type="checkbox"/> Road <input checked="" type="checkbox"/> Ped <input type="checkbox"/> Other <input type="checkbox"/> | |
| Structure Location | 0.7km north of County Road 9 | | |
| Latitude (decimal degrees) | 44.0936 | Longitude (decimal degrees) | -81.33669 |
| Owner(s) | Municipality of Brockton | Heritage: | Not Cons <input type="checkbox"/> Cons Not/App <input checked="" type="checkbox"/> List/Not Desig <input type="checkbox"/> |
| Region | Southwestern | Designation: | Design Not List <input type="checkbox"/> Design List <input type="checkbox"/> |
| District | Owen Sound | Road Class: | Freeway <input type="checkbox"/> Arterial <input type="checkbox"/> Collector <input type="checkbox"/> Local <input checked="" type="checkbox"/> |
| Old County | | No. of Lanes | 1 Posted Speed 80 (km/h) |
| Geographic Twp | Brockton | AADT | Trucks (%) |
| Structure Type | Retaining Wall | | |
| Total Deck Length | 37.7 (m) | | |
| Overall Str Width | 5 (m) | | |
| Total Deck Area | 188.5 (sq m) | Min. Vertical Clearance | (m) |
| Roadway Width | 4.1 | Special Routes: | Transit <input type="checkbox"/> Truck <input type="checkbox"/> School <input type="checkbox"/> Bicycle <input type="checkbox"/> |
| Skew Angle | 0 (deg) | Detour Length | (km) |
| No. of Spans | 1 | Direction of Structure | East/West |
| Span Lengths | 37.1 (m) | Fill on Structure | (m) |

Historical Data:

| | | | |
|---|-------------|----------------------------|------------------|
| Year Built | 1920 (est.) | Year of Last Rehab | 2003 |
| Last OSIM Inspection | 5/29/2018 | Last Evaluation | 2017 |
| Last Enhanced OSIM Inspection | | Current Load Limit | 8/13/21 (tonnes) |
| Enhanced Access Equipment (ladder, boat, lift, etc) | | Load Limit By Law | |
| | | By Law expiry Date | |
| Last Condition Survey | | Last underwater Inspection | |

Rehabilitation History:

| Date | Type | Description |
|-----------|-------|---|
| 11/1/2003 | Rehab | Replacement of steel stringers (partial) and timber deck top. |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Field Inspection Information:

Date of Inspection: 04/24/2020
(mm/dd/yyyy)

Inspection Type: OSIM

Inspector: Jesse Borges, P.Eng.

Others in Party: Trevor O'Brien, P.Eng.

Equipment Used: Hammer, camera, ladder, measuring tape

Weather: Sunny

Temperature °C: 8

Additional Investigations Required:

| | Priority | | | Estimated Cost |
|---|-------------------------------------|--------------------------|--------------------------|----------------|
| | None | Normal | Urgent | |
| Detailed Deck Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Non-destructive Delam. Survey of Asphalt-Covered Deck | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Concrete Substructure Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Detailed Coating Condition Survey | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Detailed Timber Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Post-Tensioned Strand Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Underwater Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Fatigue Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Seismic Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Structure Investigation | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Monitoring Deformations, Settlements, Movements | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Monitoring Crack Widths | <input checked="" type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | \$0 |
| Total Cost: | | | | \$0 |

Investigation Notes:

Overall Structure Notes:

Overall Comments: The structure appears to be in fair to poor condition. The steel superstructure has numerous secondary members which are permanently deformed. The floor beams below the deck are exhibiting severe corrosion and section loss which has reduced the load carrying capacity of the bridge. The concrete substructure appears to be in overall fair to poor condition with severe to very severe cracking, spalling and delaminations. The overall stability of the concrete abutments and wingwalls (especially west side) is questionable. We recommend that the structure be removed or replaced within 1 year. Until construction can be scheduled, we recommend that the bridge be closed to all vehicle traffic due to a load carrying capacity concern.

Recommended Work: Replace

Next Inspection: 04/24/2022

Recommended Work Time: <1yr

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Suspected Performance Deficiencies

- 00 None
- 01 Load carrying capacity
- 02 Excessive deformations (deflections & rotations)
- 03 Continuing settlement
- 04 Continuing movements
- 05 Seized bearings

- 06 Bearing not uniformly loaded/unstable
- 07 Jammed expansion joint
- 08 Pedestrian/vehicular hazard
- 09 Rough riding surface
- 10 Surface ponding
- 11 Deck drainage

- 12 Slippery surface
- 13 Flooding/channel blockage
- 14 Undermining of foundation
- 15 Unstable embankments
- 16 Other

Maintenance Needs

- 01 Lift & Swing Bridge Maintenance
- 02 Bridge Cleaning
- 03 Bridge Handrail Maintenance
- 04 Painting Steel Bridge Structures
- 05 Bridge Deck Joint Repair
- 06 Bridge Bearing Maintenance

- 07 Repair to Structural Steel
- 08 Repair to Bridge Concrete
- 09 Repair to Bridge Timber
- 10 Bailey Bridges - Maintenance
- 11 Animal/Pest Control
- 12 Bridge Surface Repair

- 13 Erosion Control at Bridges
- 14 Concrete Sealing
- 15 Rout and Seal
- 16 Bridge Deck Drainage
- 17 Scaling (Loose Concrete or ACR Steel)
- 18 Other

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Element Data:

| | | | |
|-----------------------|------------------------|--------------------|--------------------------|
| Element Group: | Abutments | Length: | 0.00 |
| Element Name: | Abutment Walls | Width: | 5.50 |
| Location: | Each End | Height: | 3.00 |
| Material: | Cast-in-Place Concrete | Count: | 2.0 |
| Element Type: | Conventional Closed | Total Quantity: | 33.0 |
| Environment: | Benign | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 0.0 | 16.5 | 16.5 | 1 |

Comments: The east abutment wall is in fair condition with hairline to narrow map cracking throughout. Concrete deterioration and spalling was noted at each corner of the bearing seat. The west abutment wall is in poor condition with significant concrete deterioration and spalling. The west abutment has a wide vertical crack at each wingwall connection extending fully through the structure.

| | | | | | |
|---------------------|-------------------------------------|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Replace entire bridge substructure. | | | | |

| | | | |
|-----------------------|------------------------|--------------------|-------------------------------------|
| Element Group: | Abutments | Length: | 0.60 |
| Element Name: | Ballast Walls | Width: | 4.20 |
| Location: | | Height: | 0.30 |
| Material: | Cast-in-Place Concrete | Count: | 2.0 |
| Element Type: | - | Total Quantity: | 7.6 |
| Environment: | Severe | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 5.7 | 1.9 | 0.0 | |

Comments: Portions of ballast wall replaced in 2003 are in good condition. Remaining portions of ballast wall are in fair condition. Portions of ballast wall covered with formwork.

Recommend replacing entire bridge substructure. Costed under abutment wall.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|------------------|--------------------|--------------------------|
| Element Group: | Abutments | Length: | 0.18 |
| Element Name: | Bearings | Width: | 0.15 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 14.0 |
| Element Type: | Plate | Total Quantity: | 14.0 |
| Environment: | Moderate | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 0.0 | 0.0 | 14.0 | |

Comments: Bearing pads under stringers are in poor condition with significant corrosion and section loss.
Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|------------------------|--------------------|--------------------------|
| Element Group: | Abutments | Length: | 4.70 |
| Element Name: | Wingwalls | Width: | 1.00 |
| Location: | Each Quadrant | Height: | 2.30 |
| Material: | Cast-in-Place Concrete | Count: | 4.0 |
| Element Type: | Reinforced Concrete | Total Quantity: | 43.2 |
| Environment: | Benign | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 0.0 | 10.8 | 32.4 | 1 |

Comments: Northwest and southwest wingwalls are in poor condition with severe spalling and wide vertical cracks at abutment wall connection. Northeast wingwall is in poor condition with extensive map cracking with efflorescence. Southeast wingwall is in fair condition with light scaling and map cracking noted.
Recommend replacing entire bridge substructure. Costed under abutment wall.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|--------------------|--------------------|--------------------------|
| Element Group: | Accessories | Length: | 0.00 |
| Element Name: | Signs | Width: | 0.00 |
| Location: | Each Quadrant | Height: | 0.00 |
| Material: | Steel | Count: | 4.0 |
| Element Type: | - | Total Quantity: | 4.0 |
| Environment: | Moderate | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 4.0 | 0.0 | 0.0 | |

Comments: 4 hazard signs installed at bridge.

Recommend installing additional signage (narrow bridge, yield to oncoming traffic, etc.) at bridge. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|------------------------------|--------------------|--------------------------|
| Element Group: | Approaches | Length: | 112.00 |
| Element Name: | Barriers | Width: | 0.00 |
| Location: | Each Quadrant | Height: | 0.00 |
| Material: | | Count: | 1.0 |
| Element Type: | Steel Flex Beam on Wood Post | Total Quantity: | 112.0 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | Hot dip galvanizing | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 53.0 | 20.0 | 39.0 | 8 |

Comments: Southwest has 10m of impact damage. Northwest has 2m of impact damage. Entire section of guiderail at southeast in poor condition. Posts in overall good to fair condition with signs of deterioration and rot.

| | | | | | |
|---------------------|---|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Replace guiderail system and install code compliant end treatments. | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|-----------------|--------------------|--------------------------|
| Element Group: | Approaches | Length: | 6.00 |
| Element Name: | Wearing Surface | Width: | 4.30 |
| Location: | | Height: | 0.00 |
| Material: | Gravel | Count: | 2.0 |
| Element Type: | - | Total Quantity: | 51.6 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 46.6 | 5.0 | 0.0 | |

Comments: East approach is gravel and in good condition. West approach is paved and in good to fair condition with ruts.

| | | | | | |
|---------------------|--|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Pave approaches and bridge deck top during bridge replacement. | | | | |

| | | | |
|-----------------------|----------------|--------------------|--------------------------|
| Element Group: | Barriers | Length: | 34.70 |
| Element Name: | Hand Railings | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | Single Railing | Total Quantity: | 69.4 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 0.0 | 0.0 | 69.4 | 1 |

Comments: 2" tube railing in poor condition with several broken connections, deformations and impact damage. Railing has medium to severe corrosion throughout.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|------------------------------------|--------------------|--------------------------|
| Element Group: | Barriers | Length: | 37.70 |
| Element Name: | Railing Systems | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | Steel Flex Beam over Other Railing | Total Quantity: | 75.4 |
| Environment: | Severe | Limited Inspection | <input type="checkbox"/> |
| Protection System: | Hot dip galvanizing | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 0.0 | 75.4 | 0.0 | |

Comments:

Guide rail over bridge is in fair condition with localized impact damaged noted.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|--------------------|--------------------|-------------------------------------|
| Element Group: | Beams | Length: | 5.00 |
| Element Name: | Floor Beams | Width: | 0.14 |
| Location: | | Height: | 0.38 |
| Material: | Steel | Count: | 7.0 |
| Element Type: | I-Type | Total Quantity: | 35.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 5.0 | 7.5 | 22.5 | 1 |

Comments:

Floor beams are in fair to poor condition. First and third floor beam from west are in poor condition with severe corrosion and perforations noted. First floor beam from east is in poor condition with perforations and deep pitting noted. Second floor beam from west has been replaced during last rehabilitation. Limited inspection due to water level.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|-----------|--------------------|-------------------------------------|
| Element Group: | Beams | Length: | 37.70 |
| Element Name: | Stringers | Width: | 0.13 |
| Location: | | Height: | 0.21 |
| Material: | Steel | Count: | 7.0 |
| Element Type: | I-Type | Total Quantity: | 263.9 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 0.0 | 263.9 | 0.0 | |

Comments: Steel stringers are in fair condition with extensive light to medium surface corrosion. Stingers spaced at 0.62m. Limited inspection due to water level.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|---------------------|--------------------|-------------------------------------|
| Element Group: | Bracing | Length: | 0.00 |
| Element Name: | Bracing | Width: | 0.00 |
| Location: | Between floor beams | Height: | 0.00 |
| Material: | Steel | Count: | 8.0 |
| Element Type: | - | Total Quantity: | 8.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 0.0 | 4.0 | 4.0 | |

Comments: 1" diameter tube x-bracing installed between floor beams. X-bracing is in fair to poor condition with extensive medium corrosion. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | | | | |
|-----------------------|---|------|---------------|-------|--------------------|---------------------------|
| Element Group: | Coatings | | | | Length: | 0.00 |
| Element Name: | Structural Steel | | | | Width: | 0.00 |
| Location: | | | | | Height: | 0.00 |
| Material: | | | | | Count: | 1.0 |
| Element Type: | Epoxy Zinc/Epoxy/Urethane | | | | Total Quantity: | 1.0 |
| Environment: | | | | | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | | | | |
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | All | 0.0 | 0.0 | 0.0 | 1.0 | |
| Comments: | <p>Structural steel coating is in poor condition with 95% section loss.</p> <p>Recommend replacing entire bridge superstructure. Costed under deck top.</p> | | | | | |
| Recommended Work: | | | Maint. Needs: | | | Maint. Priority: |
| Recommended Timing: | None | | Maint. Desc.: | | | |
| Work Details: | | | | | | |

| | | | | | | |
|-----------------------|--|------|---------------|-------|--------------------|---------------------------|
| Element Group: | Decks | | | | Length: | 37.70 |
| Element Name: | Deck Top | | | | Width: | 4.30 |
| Location: | | | | | Height: | 0.00 |
| Material: | Wood | | | | Count: | 1.0 |
| Element Type: | Laminated Wood Decking - transverse | | | | Total Quantity: | 162.1 |
| Environment: | Severe | | | | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | | | | |
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | sq.m. | 0.0 | 116.1 | 40.0 | 6.0 | |
| Comments: | <p>2x6 laminated deck is in good to fair condition with signs of localized deterioration and rutting. Deck top replaced in 2003.</p> | | | | | |
| Recommended Work: | Replace | | Maint. Needs: | | | Maint. Priority: |
| Recommended Timing: | <1 Year | | Maint. Desc.: | | | |
| Work Details: | <p>Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal.</p> | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|----------------------------------|--------------------|-------------------------------------|
| Element Group: | Embankments & Streams | Length: | 0.00 |
| Element Name: | Embankments | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Soil | Count: | 4.0 |
| Element Type: | - | Total Quantity: | 4.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 4.0 | 0.0 | 0.0 | |

Comments: Embankments appear to be in good condition. Review limited due to heavy vegetation.

| | | | | | |
|---------------------|--|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Embankments to be excavated and reconstructed during bridge replacement. | | | | |

| | | | |
|-----------------------|----------------------------------|--------------------|--------------------------|
| Element Group: | Embankments & Streams | Length: | 0.00 |
| Element Name: | Streams and Waterways | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | | Count: | 1.0 |
| Element Type: | - | Total Quantity: | 1.0 |
| Environment: | | Limited Inspection | <input type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | All | 0.0 | 1.0 | 0.0 | 0.0 | |

Comments: Watercourse appears to be in good condition.

| | | | | | |
|---------------------|--|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|--|--------------------|-------------------------------------|
| Element Group: | Foundations | Length: | 0.00 |
| Element Name: | Foundation (below ground level) | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Cast-in-Place Concrete | Count: | 2.0 |
| Element Type: | Spread | Total Quantity: | 2.0 |
| Environment: | Benign | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 1.0 | 0.0 | 1.0 | |

Comments: Foundations are not visible but east appears to be stable. Stability of west foundation is questionable due to wide vertical cracks in wingwalls. Foundation construction method is currently unknown.

| | | | | | |
|---------------------|-----------------------------|---------------|--|------------------|--|
| Recommended Work: | Replace | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | <1 Year | Maint. Desc.: | | | |
| Work Details: | Replace bridge foundations. | | | | |

| | | | |
|-----------------------|-----------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 37.10 |
| Element Name: | Bottom Chords | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | - | Total Quantity: | 74.2 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 37.1 | 37.1 | 0.0 | |

Comments: 2 - L3x3x5/16 with steel straps. Bottom chord appears to be in good to fair condition with light to medium corrosion. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|-----------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 0.00 |
| Element Name: | Connections | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 1.0 |
| Element Type: | Riveted | Total Quantity: | 1.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | All | 0.0 | 0.0 | 1.0 | 0.0 | |

Comments: Truss connections appear to be in good to fair connection with light to medium surface corrosion. Some connections have been permanently deformed. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|-----------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 42.30 |
| Element Name: | Top Chords | Width: | 0.36 |
| Location: | | Height: | 0.21 |
| Material: | Steel | Count: | 2.0 |
| Element Type: | Channel | Total Quantity: | 84.6 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | m | 0.0 | 42.3 | 39.3 | 3.0 | |

Comments: Back-to-back c-channels (8x2x1/4) with steel top plate. Top chord is in good to fair condition with extensive light to medium surface corrosion and pitting. Minor impact damage noted at southeast and northwest. Top plate is exhibiting rolling due to corrosion. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

| | | | |
|-----------------------|---------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 7.00 |
| Element Name: | Verticals/Diagonals | Width: | 0.00 |
| Location: | | Height: | 0.00 |
| Material: | Steel | Count: | 20.0 |
| Element Type: | - | Total Quantity: | 20.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 9.0 | 9.0 | 2.0 | |

Comments: Size of diagonal bracing varies based on location. Diagonal bracing is generally in good to fair condition with extensive light to medium surface corrosion. Diagonal brace at northeast is permanently deformed. Bottom connection of diagonal brace at southeast is permanently deformed. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

| | | | |
|-----------------------|--------------------------|--------------------|-------------------------------------|
| Element Group: | Trusses/Arches | Length: | 5.20 |
| Element Name: | Verticals/Diagonals | Width: | 0.00 |
| Location: | Vertical Bracing at Ends | Height: | 0.00 |
| Material: | Steel | Count: | 14.0 |
| Element Type: | - | Total Quantity: | 14.0 |
| Environment: | Moderate | Limited Inspection | <input checked="" type="checkbox"/> |
| Protection System: | | | |

| | | | | | | |
|-----------------|--------|------|-------|-------|-------|---------------------------|
| Condition Data: | Units: | Exc. | Good: | Fair: | Poor: | Performance Deficiencies: |
| | Each | 0.0 | 6.0 | 6.0 | 2.0 | |

Comments: Size of vertical bracing varies. Bracing is generally in good to fair condition with extensive light to medium surface corrosion. Vertical brace at southwest and northeast permanently deformed. Limited inspection due to height restrictions.

Recommend replacing entire bridge superstructure. Costed under deck top.

| | | | | | |
|---------------------|------|---------------|--|------------------|--|
| Recommended Work: | | Maint. Needs: | | Maint. Priority: | |
| Recommended Timing: | None | Maint. Desc.: | | | |
| Work Details: | | | | | |

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

Repair / Rehabilitation Required

| Element Group | Element | Repair / Rehabilitation | Priority | Const Cost |
|-----------------------|---------------------------------|---|----------|------------|
| Abutments | Abutment Walls | Replace entire bridge substructure. | <1 Year | \$75,000 |
| Approaches | Barriers | Replace guiderail system and install code compliant end treatments. | <1 Year | \$39,000 |
| Approaches | Wearing Surface | Pave approaches and bridge deck top during bridge replacement. | <1 Year | \$10,000 |
| Decks | Deck Top | Recommend replacing entire bridge superstructure with a single-lane prefabricated bridge system. Cost includes existing bridge removal. | <1 Year | \$720,000 |
| Embankments & Streams | Embankments | Embankments to be excavated and reconstructed during bridge replacement. | <1 Year | \$80,000 |
| Foundations | Foundation (below ground level) | Replace bridge foundations. | <1 Year | \$79,000 |

Total Repair/Rehabilitation Cost \$1,003,000

Associated Work

| | Comments | Estimated Cost |
|------------------------------------|--|--------------------|
| Approaches | | \$0 |
| Detours | | \$0 |
| Traffic Control | <i>Traffic Control and Signage</i> | \$10,000 |
| Utilities | | \$0 |
| Right-of-Way | | \$0 |
| Environmental Study | | \$0 |
| Other | <i>Site Mob. And Demob., Environmental Protection and Dewatering</i> | \$130,000 |
| Contingencies | | 10.00% \$114,000 |
| Engineering | | 10.00% \$114,000 |
| Total Associated Work Cost | | \$368,000 |
| Total Repair / Rehabilitation Cost | | \$1,003,000 |
| Total Cost | | \$1,371,000 |

Justification

Due to the current condition of the bridge, we are recommending that the structure be removed or replaced within 1 year. It is our opinion that performing any major repairs to this structure would only delay the structure's eventual closure/replacement and would not be financially beneficial to the Municipality.

The Municipality of Brockton has retained GM BluePlan Engineering to complete a Municipal Class Environmental Assessment (Schedule 'B') on the structure to determine the impacts to the surrounding environment, including local agricultural and residential communities, if the following solutions are implemented:

- a) Permanent Bridge Removal (\$ 347,000)
- b) One-Lane Bridge Replacement (\$ 1,371,000)
- c) Two-Lane Bridge Replacement (\$ 1,665,000)

It should be noted that cost estimates provided have been prepared with limited design details and are based on probable conditions affecting the project. Therefore, cost estimates are intended to reflect the approximate magnitude of the project costs. A more detailed assessment of the overall project costs will be completed as part of the design phase once a preferred solution has been identified. The cost estimates do not include any major roadway work that may be required if the bridge is replaced.

Ontario Structure Inspection Manual - Inspection Form

Site Number: 0002

Structure Name: Riversdale Bridge

Structure ID: 1

In the meantime, it is our opinion that the condition of the steel stringers and west abutment wall are severe which has reduced the overall structural capacity of the bridge. Although a load evaluation would need to be completed to confirm, we believe that the current load limit is no longer appropriate. Therefore, we are recommending that the bridge be closed to all traffic as soon as possible until construction can be scheduled in 2021.

Ontario Structure Inspection Manual - Inspection Form

Structure Name

Site Number:

Structure ID:

Inspection Photos



View of structure looking southeast.



View of structure looking west



View of soffit looking east.



View of deck top looking east.



Localized deterioration of deck top.



Severe corrosion and deformations at railing system.



Impact damage on top chord at southeast.



Permanent deformation of vertical web at northeast.



Impact damage on diagonal brace at southeast.



Impact damage and rotation of southeast guide rail.



View of east abutment wall.



View of west abutment wall.



Map cracking with efflorescence at northeast wingwall.



Severe spalling at northeast bearing seat.



Wide vertical crack with daylight at northwest wingwall.



Void in approach at northwest due to wingwall crack.



Wide vertical crack at southwest wingwall.



Severe corrosion and section loss of east bearing pad.



Severe section loss and large perforations at west stringer.



Severe section loss and large perforations at west stringer

ATTACHMENT C:
BROCKTON MUNICIPAL HERITAGE COMMITTEE

June 8, 2020
GMBP File: 212326

Via Email: sjohnson@brockton.ca

Brockton Heritage and Library Committee
100 Scott Street
Walkerton, ON N0G 2V0

Attention: Ms. Sarah Johnson
Committee Secretary

Re: Request for Review and Comment
Bridge No.0002 (Greenock)
Riversdale, Municipality of Brockton

Dear: Ms. Johnson

GM BluePlan Engineering Limited (GMBP) was retained by the Municipality of Brockton to undertake a planning process toward addressing the deteriorated condition of Bridge No.0002 (Greenock), situated on Bridge Street in Riversdale (Lot 30, Concession 1N), just north of Highway 9. The Municipal Engineers Association, in cooperation with the Ministry of the Environment, Conservation and Parks (MECP), has developed a Municipal Class Environmental Assessment (EA) process to assist in planning projects of this nature.

The Municipal Class EA outlines a comprehensive planning process that provides a rational approach to consider the advantages and disadvantages of various alternatives on several 'environments' in order to determine a *Preferred Solution* to address an identified problem (or opportunity). The assessment process is to include consideration for the technical, social, natural heritage, cultural and economic implications and potential mitigation measures. The process also involves consultation with various government agencies, indigenous communities and the public. Based on feedback from the Ministry of Heritage, Sport, Tourism and Culture Industries (MHSTCI) regarding the Cultural Heritage assessments for similar projects, we are requesting that the Brockton Heritage and Library Committee review and provide comment on the Cultural Heritage Evaluation Report which was prepared as part of the background documentation for the process.

REQUEST FOR REVIEW AND COMMENT

A key part of the heritage conservation framework includes consultation with groups that may have a potential interest in the future of a given structure. As a result, the Brockton Heritage and Library Committee is being requested to review and provide comment on the Cultural Heritage Evaluation Report and Preliminary Heritage Impact Assessment for Bridge No.0002 (Riversdale), prepared by Scarlett Janusas Archaeology Inc. (July 21, 2017, revised August 25, 2018), herein referred to as the CHER/HIA. A copy of the report is enclosed, and a summary of the findings is provided herein.

The findings of the CHER/HIA are used to inform the cultural heritage 'environment' of the alternatives considered for the Riversdale Bridge EA Process, including bridge replacement, rehabilitation or removal. We expect that the MHSTCI will request that the local Heritage Advisory Committee be included in the consultation efforts for this undertaking. Therefore, we are requesting the Brockton Heritage and Library Committee to confirm the following:

- ☐ That the Brockton Heritage and Library Committee has reviewed the CHER/HIA (revised August 2018).

- ☐ The Brockton Heritage and Library Committee supports (or otherwise) the conclusions with respect to the cultural heritage value assigned to the Riversdale Bridge.
- ☐ The Brockton Municipal Heritage Committee supports (or otherwise) the removal and/or replacement of the Riversdale Bridge.
- ☐ The Brockton Municipal Heritage Committee supports (or otherwise) the mitigation measures proposed in the CHER/HIA (summarized below) for the alternative(s) being considered at this time.

SUMMARY OF FINDINGS AND RECOMMENDATIONS (CHER/HIA)

Cultural heritage assessments are required as part of the EA planning process which necessitates *'the conservation of features of significant architectural, cultural, historical, archaeological or scientific interest'*. The CHER/HIA was completed to inform the cultural heritage aspects of the Riversdale Bridge Environmental Assessment process. A summary of the findings is provided below.

Report Findings

Based on a search of the of the municipal, provincial and federal registers, Riversdale Bridge is not designated as being a property of cultural heritage value or interest. However, to determine the potential cultural heritage value of the subject bridge the "Criteria for Determining Cultural Heritage Value or Interest" set out in Ontario Regulation 9/06 under the Ontario Heritage Act (OHA), as amended in 2005, were used. The CHER identified that the bridge met several of the cultural heritage assessment criteria. Input from the local Heritage Committee is being sought to gauge the degree of local interest in these elements.

Design or Physical Value

The bridge is representative of a single-span, 8-panel, rivet-connected Pratt through-truss bridge. Heritage attributes identified, specific to the subject bridge include the following:

- i. Cast-in-place concrete abutments;
- ii. Steel, single span with 8-panel design;
- iii. Rivet-connected skeletal framework, including diagonal steel members and horizontal bracing; and
- iv. Timber deck beams (replaced in 2003).

At this time, the Riversdale Bridge is one of four remaining metal rivet-connected Pratt through-truss bridges in Bruce County. Other similar bridges within the County include the following:

1. **Kolb Bridge (7-Panel):**

This single-span bridge is situated approximately 35 km north of Riversdale, directly south of Port Elgin, in the Town of Saugeen Shores.

2. **Watson's Bridge (7-Panel):**

This bridge, which was repaired in 2015, is located approximately 20 km north-northwest of Riversdale along the Greenock-Elderslie Townline Road and is maintained by the County of Bruce. It crosses over the Teeswater River south of Paisley.

3. **Old CR-3 Bridge (8-Panel):**

This two-span Pratt through-truss bridge is reportedly noted for its *'high degree of historic integrity with no major alterations'* (Historic Bridges Webpage). It is located approximately 42 km north of Riversdale in the Municipality of Saugeen Shores. Although the bridge no longer supports vehicular traffic, it has been left in-situ for off-road and non-motorized use only and a new vehicular bridge was constructed nearby.

In addition, approximately 12 kilometres northeast of Riversdale, north of Chepstow, there remains a similar 8-panel Pratt through-truss bridge commonly referred to as the Concession Road 8 Bridge. However, while the majority of the metal truss bridges have riveted connections, the Concession 8 Bridge has pinned connections which are considered less common.

Preliminary investigations suggest that within the surrounding area several other similar Pratt through-truss bridges remain including five (5) in Grey County, three (3) in Wellington County, two (2) in Huron County and one in Perth County.

Historical or Associative Value:

The Riversdale Bridge demonstrates the work or ideas of a builder (or designer/engineer) that may be significant to the community. The bridge was built by the Hunter Bridge & Boiler Company of Kincardine which was established in 1887 by the Hunter brothers. Alexander and Robert Hunter were reportedly born in Brant County (i.e. near Hamilton) in 1851 and 1846, respectively, and moved to Bruce County in 1856.

The bridge may have direct associations with a theme that may be significant to the community or may have the potential to yield information that contributes to the understanding of the community as it served as an early transportation route serving the local agricultural community.

Contextual Value

The bridge contributes to the landscape character of the area, emphasizing its function to serve as a conduit to areas on either side of the Teeswater River.

The CHER concluded that *"the bridge has been evaluated as having cultural heritage value and interest"*.

We request that the Brockton Heritage and Library Committee review these findings and provide concurrence or other commentary.

Proposed Mitigation Measures

A preliminary Heritage Impact Assessment (HIA) was also included in the CHER, better to inform the alternatives that will be considered in the EA process. In consideration of the *Ontario Heritage Bridge Guidelines Conservation Options*, there are several mitigation options that may be considered for the alternatives under review. It is noted that based on recent inspection reports it is our opinion that it is unlikely that bridge rehabilitation will be a viable option for this structure, due to the significant cost, marginal increase in life span, and the low traffic volume on this road. Therefore, the mitigation measures outlined below focus on two alternatives, including bridge removal and bridge replacement. Mitigation measures considered for these alternatives include the following:

- i. Commemoration: The Municipality may consider the preparation of a historical plaque (or monument) to commemorate the cultural heritage associated with the Riversdale Bridge for permanent installation at the Site.
- ii. Documentation: The history of the Riverdale Bridge is contained within the CHER/HIA. No known original drawings of the structure have been located, however, general schematic drawings of rivet-connected Pratt through-truss bridges and photos of the existing structure are contained within the CHER/HIA. As a mitigation measure, it is recommended that the CHER/HIA (revised August 25, 2018), and other relevant reports, form the documentation for Bridge No. 0002. Furthermore, it is recommended that a hard copy or digital copy be deposited, as a single documentation report, at the Walkerton Branch of the Bruce County Library System and at the Bruce County Museum and Cultural Centre.

AND/OR

- iii. Salvage elements for incorporation into new structure, conservation and/or displays (latter could include heritage parks, museums etc.).



We request that the Brockton Heritage and Library Committee consider these mitigation measures and provide concurrence, or other commentary.

Should you have any questions, please feel free to contact the undersigned.

Yours truly,

GM BLUEPLAN ENGINEERING LIMITED

Per:

A handwritten signature in blue ink that reads 'Melissa Robinson'.

for Andrea Nelson, M.Sc.
AN/mr

cc: File No. 212326

RELEVANT DOCUMENTATION

Copy of the Cultural Heritage Evaluation Report and Preliminary Heritage Impact Assessment for Bridge No.0002, prepared by Scarlett Janusas Archaeology Inc. (July 21, 2017; Revised August 25, 2018).

Drea Nelson - GM BluePlan

From: Sarah Johnson <SJohnson@brockton.ca>
Sent: Tuesday, September 15, 2020 10:09 AM
To: Drea Nelson - GM BluePlan
Cc: Jesse Borges - GM BluePlan; Brent Willis - GM BluePlan; Fiona Hamilton
Subject: RE: 212326 Brockton Heritage and Library Committee: Request for Review and Comment

Good morning Drea,

The Brockton Heritage Committee met last night (September 14, 2020), and passed the following Resolution:

Moved by Dean Leifso Seconded by Barb Kerry

That the Brockton Heritage Committee recommends the preferred Option #1 for the heritage and conservation of Bridge No. 0002, subject to additional cost analysis of the various options.

Carried.

I have copied Fiona Hamilton, our Clerk in this email since she was present at the Heritage Committee Meeting and can provide further information if necessary.

Thank you,

Sarah Johnson
Jr. Deputy Clerk

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